U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DIVISION

ECONOMIC AND ENGINEERING FEASIBILITY STUDY

COMMON PIPELINE SYSTEM

FOR

FORE RIVER
PORTLAND HARBOR, MAINE

FREDERIC R. HARRIS, INC.
CONSULTING ENGINEERS

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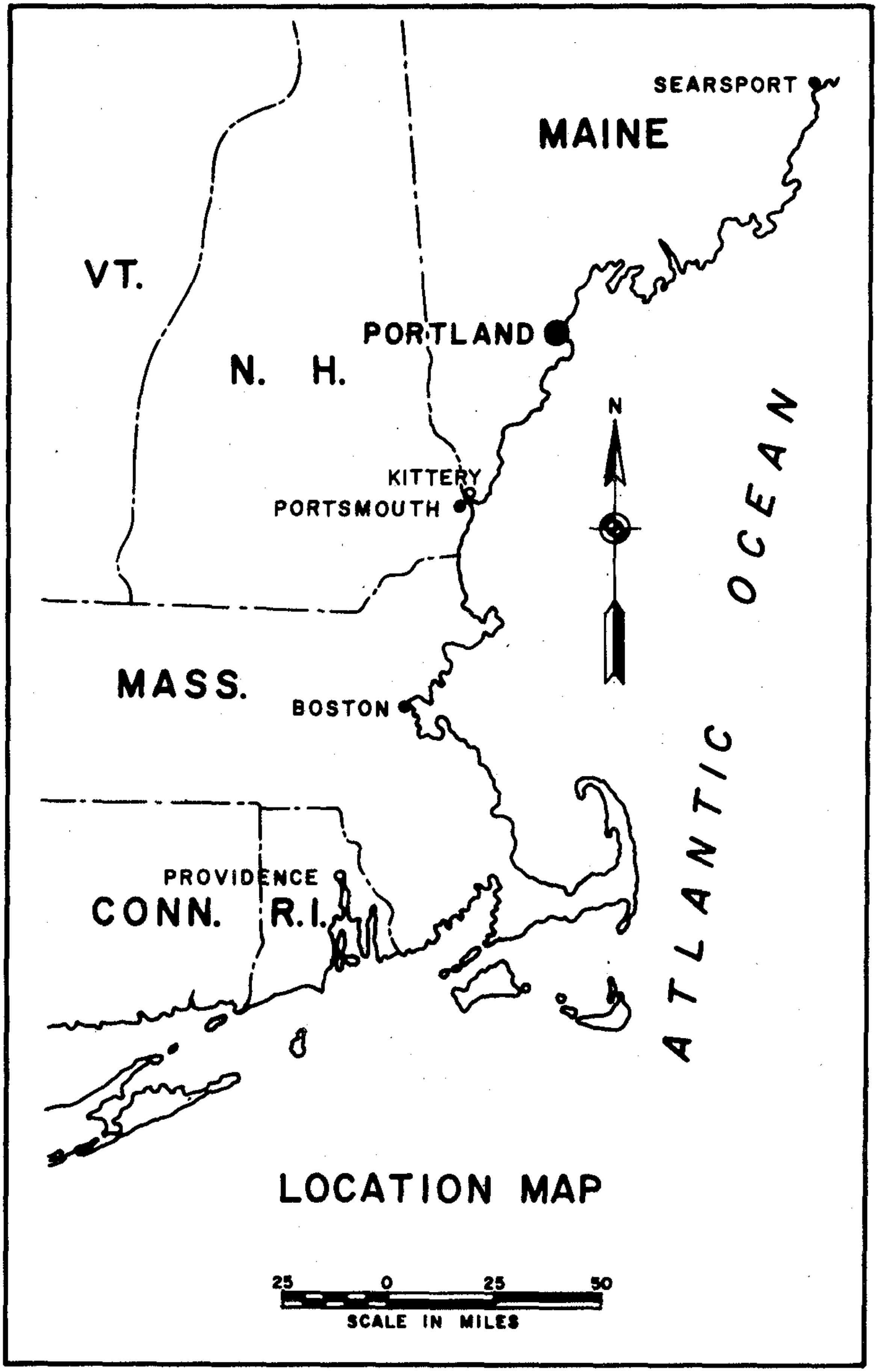
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I. INTRODUCTION

This report presents the results of a study to determine the feasibility and cost of transferring refined petroleum products from tankers to existing storage facilities, adjacent to Fore River Channel, by means of a common pipeline system.

The study was accomplished pursuant to Contract No. DACW 33-73-C-0156 with the U.S. Army Corps of Engineers, New England Division, dated 29 June 1973 entitled "Study of Common Pipeline System, Fore River, Portland Harbor, Maine."

At this point the study team wishes to acknowledge with thanks, the time and effort expended by the Portland Port Authority, the City Manager of South Portland, the Portland Pilot Association, Central Wharf Towboat Company, Inc., and representatives of all major oil companies in the Portland Harbor area. A particular expression of gratitude is due Mr. Edward Langlois, Director, Bureau of Waterways, State of Maine Department of Transportation.

II SUMMARY

This section of the report summarizes the results of the study to determine the feasibility and cost of transferring refined petroleum products from tankers to existing storage facilities adjacent to Fore River Channel by means of a common pipeline system.

In an overall perspective the pipeline system is an alternative to extensive dredging of the river channel and reconstruction of the existing Portland Bridge, the inadequate vertical and horizontal dimensions of which limit existing traffic to barges and tankers up to 25,000 tons and, effectively prohibits passage and access of larger tankers to the existing product terminals located in the upper river region beyond the bridge.

Prior to selection of the proposed feasible alternative systems,described in succeeding paragraphs, the following data pertinent to the study were evaluated:

a. Potential participants and users of a common oil pipeline and terminal including storage capacity, location of existing terminals and present mode of operations.

b. Annual product imports by item and quantity.

c. Favorability and availability of lands and properties adjacent to the approach channel and to Fore River Channel.

d. State and local interests at Portland Harbor.

e. Availability and size of approaches and turning basins.

f. General site conditions including topography, weather, tides, and wave-wind conditions.

g. Ecological impact of operations of existing terminals. what about Ecol Imp of proposed terminals?

Three alternative schemes "A", "B", and "C" for the construction of a connecting common use pipeline system and marine terminal were developed. These schemes are based on the information obtained from the above data and the market study. Additional factors considered in the planning of the facilities were the favorable responses by the operators of the terminals and State and local government authorities to the concept of a new receiving terminal and pipeline system.

Two general areas for development were investigated.

- South Portland offers two possible sites: alternatives "A" and "B" along the south bank of Fore River, with the piers located at either the mouth or in the approach channel of the River. These alternative areas are shown in Figures 2 and 3.

- Luckse Sound, with an island pier located to the west of Cliff Island, encompassing Long Island with its present tank farm and facilities as shown in Figure 4.

Alternative "A" described in Section F, represents an inharbor receiving terminal interconnected by the pipeline system to the intermediate tank farm and pumping station, then to the individual oil distribution terminals.

This terminal is referred to as a two-phase development scheme, initial and expanded. The initial scheme will accomodate the immediate and near future requirements of the Port. The expanded scheme would be utilized at such a point in time when the volumes of petroleum products received, or the size of the vessels, demand a larger facility.

Economically, Alternative "A" is the most feasible as it requires the least amount of capital cost and construction time, combined with flexibility for future expansion. This scheme is, however, contingent upon the availability and cost of acquiring the existing Portland Pipeline Pier No. 1. In conversation with the management of Portland Pipeline Company, which operates this pier, they indicated that there is a good possibility of their selling the property due to the present infrequent use. In the event that the pier is not available for any number of reasons, the next step would be the construction of Alternative "B".

Alternative "B" common pipeline system scheme shown in Figure 3 is a single-phase construction development scheme. This plan is similar to Alternative "A" with the exception of the location of the pier, which is located near the approach channel to the harbor.

This 50,000 DWT berth would immediately provide the port with a higher volume flow of product and accomodate a greater range of vessel size. Although Alternative "B" would cost more than the initial Alternative "A" program, it would be approximately $2,000,000 less than the expanded Alternative "A". The construction time would be greater, but the advantage would be a completed economically superior facility which would be capable of handling the throughput of products for the foreseeable future.

The feasibility of Alternative "C" common pipeline system, shown in Figure 4 with system flow diagram in Figure 7 is based on the same principle as Alternative "A" and "B". The marine terminal is located off Cliff

Island in Luckse Sound for the purpose of utilizing the sheltered deep water. The island pier would be connected by submarine pipeline to the present tank farm on Long Island and then by submarine and land pipeline to the mainline and to the respective oil terminals.

This scheme utilizes the existing former U.S. Navy tank farm on Long Island owned by King Resources Company. Aside from the obvious savings in construction cost, the site has an additional 50 acres which would be available for a pumping station and additional storage area as required.

Although requiring almost twice the capital cost of Alternative "A" and "B", this scheme offers a wide scope of advantages such as the ability to be utilized as a crude oil receiving terminal to incorporate the newest in pollution control devices, to reduce navigational delays and risks of collisions, and to handle 50% more product throughput than is actually required.

Due to the gradual phasing out of smaller tankers (18,000 to 21,000 tons), this facility would result in the maximum of freight savings by the use of larger and more economical vessels. This site would also be applicable for use as an off-loading point for shipments throughout the northeast, to proposed refineries and to the Boston area.

In essence, this facility could very well become a major super-tanker terminal handling all types of product and crude oil with ample room for expansion.

III DISCUSSION

A. STUDY

1. Inventory Survey

As its first task the project included the conducting of a survey of the existing oil product receiving terminals. Interviews were held with potential participants in the proposed common pipeline system to determine the annual imports by item and quantity, present capacities of existing storage tanks and the availability of land for possible future expansion of these facilities.

The object of the survey was to establish a preliminary basis for future demands of products, size of pipeline system and tankers in which the products would be transported.

2. Existing Piers and Tank Farms

Inventories of existing marine facilities and storage tanks were made to evaluate their capacities for handling present and future throughputs. The type of construction and the condition of existing piers, and the manner of operation of the loading and unloading facilities, including existing pollution measures, were investigated. Observations were also made of the present manner of maneuvering tankers prior to berthing and after deberthing in the channel approach to the existing Portland Bridge spanning the Fore River, and in the channel above the bridge.

3. Existing Channel and Bridge

An additional study was made of the present channel and turning basin dimensions, including the available depths and the restrictions imposed by Portland Bridge. Effects of the above conditions, the influence of tidal variations on present and future product tanker traffic, and also the bridge traffic were considered. Besides evaluating the data shown on available drawings and other documents, discussions were held with State and Local Authorities including the pilots of the Portland

Pilot Association and pilots of Central Wharf Towboat Company, Inc. in Portland Harbor, to acquire additional background data for the evaluation of present operations and the need for planned construction of a common pipeline system, including a new marine terminal.

4. Site Location

Investigations encompassed the evaluation of existing land conditions for determination of the most favorable terrain for a common pipeline route, present occupancy of land and its availability for the pipeline and intermediate tank farm system, including selection of the most adequate location for a marine terminal.

B. GENERAL SITE CONDITIONS

1. Wind

Wind statistics for Portland City Airport were based on records of hourly observations taken of wind speed and direction over a ten year period, from 1951 through 1960. Wind Rose constructed from these above statistics is shown in Figure 11.

Winds of 0-7 mph occur predominantly from North over West to South. Winds of 8 to 18 mph, in addition to occurring mainly from the same direction as above, occur also from North-northeast, East and South-southeast. Winds of 19 to 31 mph occur predominantly from West-southwest, West, South, North, and North-northeast with total duration of 5.5% of the time.

The strongest winds, 47 mph, and greater, occur mainly from the East, East-southeast, and South-southeast with a total duration of less than 0.05% of the time. The greatest wind velocity recorded over a 23-year period was 76 mph from the Northeast.

Winds generate waves in the vicinity of the existing Portland Pipeline Pier No. 2 where the proposed 50,000 DWT Tanker Terminal is located; however, due to the limited fetch and protection provided by the existing breakwater, the wave heights are small. Similarly, at the alternative location for the 100,000 DWT berths at the Cliff Island, the lands of Long Island and Great Chebeaque Island prevent development of sizeable Northerly and Westerly wind generated waves due to limited fetch.

Southerly and Southeasterly winds generate waves higher than those generated by the above-described wind direction due to longer fetch; however, neither tanker traffic nor berth occupancy will be affected. Moreover, the land mass and shallow waters will additionally protect the berth from Southerly and Southeasterly wind generated waves.

Except for an occasional hurricane, the wind conditions do not present any unusual problems to vessels entering the Portland Harbor area nor to vessels berthed in its vicinity; therefore, no appreciable problems should be encountered by tankers entering the locations of the proposed pipeline system marine terminals.

2. Waves at Proposed Terminal Sites

East of Portland Harbor, outside the island and shoals, high waves are generated by waves formed in the Atlantic Ocean and the Gulf of Maine. These waves cause the major degree of disturbance in the approach channels to the port and to Luckse Sound.

Wave recordings representative of the location under study are not available, however, hindcast of wave conditions for two locations off the New England coast have been made by the U.S. Beach Erosion Board. The results were published in their Technical Memorandum No. 55 entitled "North Atlantic Coast Hindcast by

Bretschneider--Revised Sverdrup-Munk Method".

The locations are:

Station	Latitude	Longitude
A	43°- 50'	68°- 0'
B	41°- 50'	69°- 30'

Station A is located off Penobscot Bay, Maine and Station B is off Nauset Beach, Cape Cod, Massachusetts.

The wave heights shown are significant heights. The hindcasts were made based on weather charts through the years 1948, 1949 and 1950.

The fetch to Portland for the latter wave directions, except South, is longer than at Stations A and B. However, the wave heights do not depend upon the fetches, which are very long in all cases, but on the duration of the wind speeds which generate the waves. For calm seas, an average value was considered.

The resulting Portland wave statistics are shown in Figure 12.

Calm seas or waves from directions not shown occur approximately 41% of the time. The waves generated are of limited height and will have no adverse effect on tanker traffic and berthing. For waves approaching from the East-northeast, North, and East-Southeast directions which might be in excess of 6 feet, Cliff Island will offer considerable protection to berthing and deberthing.

It is concluded, therefore, that the deep water wave effect at the sites under consideration would be generally satisfactory for berthing operations.

3. Tides and Currents

National Ocean Survey "Tide Tables" for Casco Bay show the mean tide range for Portland Harbor and vicinity varying from 8.8 to 9.1 feet, the spring range from 10.1 to 10.5 feet, and the mean tide level from +4.4 to +4.5 feet. The extreme low water on record is 3.5 feet below MLW.

The corresponding "Tidal Current Tables" for Casco Bay show currents for the locations considered less than 1.5 knots.

While the design of the proposed berth will incorporate allowance for the variation of tide level the currents will not present unusual difficulties in traffic operations.

This condition was discussed with the Portland Pilots who substantiated these findings.

4. Fog

Information concerning fog occurence at Portland Harbor, contained in the "U.S. Coast Pilot", indicates that the areas along the coast, at the heads of bays and within the river, are often reasonably clear while very dense fog is found offshore. The situation often reverses and there is fog inshore while the sea is clear.

The Pilots of the Portland Pilot Association and the Central Wharf Towboat Company stated that Portland Harbor has never been closed because of fog, and they could see no undue difficulties of operations in the waters of Luckse Sound where ample depth and width are available.

5. Soil Conditions

Information based on past explorations by the Corps of Engineers, New England Division, by means of soil borings in the area between South Portland, House Island, Little Diamond Island, and Ft. Gorges Island, indicates that accretion has occured in the valleys of the rock surface configuration. The rock is exposed in line with islands and shoals as evidenced by numerous borings on record at the Corps office. In two cases, a 15-foot clay overburden was found as a result of borings which penetrated a maximum of 15 feet.

Core samples of rock were described generally as phyllite, phyllitic schist, or chlorite schist. Veins of quartz were found in some borings. The core recovery ranged from 0 to 100%. The phyllite and schist were generally described as fine-grained and slightly weathered. The foliation dips at least 35° but mostly up to 70°. Phyllite or schists are generally considered to be fairly soft rock; however, due to the considerable foliation dips the possibility of encountering much harder rock in the approach and terminal areas considered cannot be excluded. Additional cost of coring for future pier foundation piling may be incurred in the Luckse Sound Marine Terminal, as may additional cost of removing of pinnacles in the way of the submarine line.

Information concerning the soil conditions based on borings carried out along the center line of the existing Portland Pipeline Company Pier No. 2 indicates layers of sediment, sand, clay, silt, glacial till, and gravel, at least 70 feet thick. In view of this, no unusual pier foundation construction work is foreseen for the proposed inshore marine terminal at South Portland.

C. APPROACHES AND TURNING BASIN

1. Channel Approach to Fore River

The main entrance leading to the proposed alternative berths in Portland Harbor, the 30,000 DWT tanker berth at existing Portland Pipeline Company Pier No. 1 in Fore River, and the proposed 50,000 DWT tanker berth west of Spring Point, is from southward, between Ram and Cushing Islands located at the North, and Portland Head on the South. The 1000-foot wide entrance channel with depths of 45 feet or more leads from deep water in Casco Bay to a line opposite Fort Gorges, thence running through a maneuvering basin and anchorage area of 45-foot depth located northwest of House Island and terminating at the 35-foot channel at the mouth of Fore River.

The channel and turning basin offer adequate waterway for tankers to enter the respective berths described above.

2. Fore River

The 35-foot deep channel in Fore River runs from Fort Gorges to Veteran's Memorial Bridge. The channel width varies from approximately 1200 feet at Pier No. 1 to 300 feet near the Bridge. The channel depth and width provides adequate conditions for the proposed berth alternative at Pier No. 1.

3. Luckse Sound

The main entrance channel to Luckse Sound, leading from deep water in Casco Bay to the proposed 100,000 DWT tanker terminal at Cliff Island, is from Southward, between Peaks Island to the west and The Hussey ledge to the east. The width of this channel is in excess of 4000 feet.

Channel widths ranging from the above 4000 feet to 3500 feet, and the available draft of at least 70 feet provide for ample and desirable navigational conditions for approach and berthing of 100,000 DWT tankers.

4. Dredging

With the exception of removing the silted area at the proposed 30,000 DWT berth at Pier No. 1, estimated at an average depth of 3 feet, no major dredging will be required.

At the proposed 50,000 DWT berth, west of Spring Point the existing water depth varies from 11 feet near shore to 35 feet and 45 feet at the Fore River mouth and the approach channel, respectively. An estimated 1,600,000 cubic yards of material will require removal. Based on previously described soil conditions at Pier No. 2 no rock removal appears to be involved. The cost estimates given in Section G exclude cost of rock removal.

Since the approaches to Luckse Sound and associated manuvering areas have ample water depth and channel width, no dredging is indicated.

5. <u>Operating Limitations</u>

The locations of the proposed alternative terminals have been selected with the view of minimizing the operating limitations due to restricting conditions imposed by water depth and tide variations, especially for the inshore berths in Fore River and for the approach channel. In addition to the foregoing, and the requirements of under-keel clearances, there are limits to the sea conditions that can be tolerated with a ship at berth.

To keep the costs of the berthing structures reasonable, and to conform with generally accepted practice, the operating limit at berth is set at five-to-six-foot high significant waves. The normal operation when waves are approaching four foot significant wave height is to stop berthing ships, to continue ballasting or discharging, and then to remove those alongside the berth as soon as practicable.

Apart from sea conditions, there are insignificant operating limitations caused by wind, current and fog. The amount of wind pressure that can be tolerated depends on its direction relative to the axis of the ships. Based on pilot experience and on the wind data previously discussed, with the exception of hurricanes, no winds are expected that would limit operations once a ship is moored at either of the proposed alternative locations. Interference during berthing and deberthing operations would occur at the more exposed site at Cliff Island.

Currents, particularly in the berthing area, could have a more significant effect than winds. Broadside currents of three-quarters of a knot and greater would interfere with berthing and deberthing operations. In order to increase the berth occupancy and decrease the effect of the currents, the berth would be aligned with the current direction.

The present practice at Portland Harbor is to berth tankers during slack waters; however, with proper alignment of the proposed alternative berths the currents will have little or no effect on berthing operations outside slack water periods.

Navigating during fog is aided by radar and navigation buoys. Although operations due to fog are slowed down, no unusual delays have been reported by the pilots. The frequency of fog is minimal and should not extensively affect the operations at the proposed sites.

Considering the fully loaded drafts of tankers servicing the proposed terminal berth in Fore River at Pier No. 1, namely 32 to 35 feet for tankers of 28,000 DWT to 35,000 DWT range, approximately 3 feet underkeel clearance shall be provided. To maintain this clearance, it will be required that the deeper draft tankers not enter the berth within about 2 hours of MLW, depending on the draft of a particular vessel. No unusual delays due to this requirement are foreseen especially since there are simidiurnal tides in Fore River, and since the practice of bringing tankers on high tide is presently employed at Portland Harbor. Similar practices of transiting tankers above MLW will be required at the proposed 50,000 DWT average size tanker berth location in the approach channel to Fore River. The proposed dredged water depth at the berth of 45 feet MLW will provide approximately

5 to 6 feet clearnace normally allowed for tankers of the 65,000 DWT class drawing approximately 43 feet of water.

D. <u>THE MARKET STUDY</u>

1. <u>Purpose</u>

The primary base for this pre-design investigation of alternative means of supplying the requirements of the oil companies' distribution centers are the quantities of product and the anticipated number and sizes of vessels calling on the Fore River section of Portland Harbor. The market study has been directed toward forecasting this demand based on data obtained from correlating government and industry projection statements in conjunction with the terminal operators forecasts.

2. <u>Regional Petroleum Supply and Demand</u>

In order to determine the annual requirements of the petroleum industry in Portland Harbor various information was obtained and evaluated.

A survey of past total receipts was made to indicate the historical trends in petroleum moved by the distributors. This data was obtained from Corps of Engineers Publications, "Waterborne Commerce of the United States", and is tabulated in Table "A".

"TABLE A"

TOTAL PETROLEUM TRAFFIC*PORTLAND HARBOR, MAINE

WATERBORNE COMMERCE, CORPS OF ENGINEERS' REPORT

	Receipts			Shipments		
	Foreign	Coastwise	Total	Coastwise	Local	Total
Gasoline						
1971	7,234	1,763,044	1,770,278	325,807	13,307	339,114
1970		1,513,420	1,513,420	265,650	11,722	277,372
1969		1,396,535	1,396,535	299,025	9,684	308,709
1968	8,863	1,429,265	1,438,128	288,623	3.369	291,992
1967		1,481,461	1,481,461	292,227	3,682	295,909
1966		1,643,524	1,643,524	311,936	1,939	313,875
#2 Dist						
1971	11,216	1,660,257	1,671,473	306,222		306,222
1970	26,095	1,581,647	1,607,562	202,980	4,772	207,752
1969		1,832,625	1,832,625	429,693	137,812	567,505
1968	15,164	1,512,410	1,527,574	195,985	18,764	214,749
1967	20,781	1,374,645	1,395,426	233,270	4,396	237,666
1966	28,546	996,422	1,024,968	220,383	7,183	227,566
#6 Dist						
1971	1,423,438	182,533	1,605,971	199,141	398,485	597,625
1970	1,367,198	506,251	1,873,449	373,642	467,374	841,016
1969	1,137,024	317,056	1,454,080	245,213	420,808	666,021
1968	1,085,896	449,527	1,535,423	7,829	173,008	180,837
1967	1,450,835	6,380	1,457,215		108,357	108,357
1966	1,408,361	36,357	1,444,718		104,353	104,353

* In Tons

"TABLE A" (Cont'd)
TOTAL PETROLEUM TRAFFIC*PORTLAND HARBOR, MAINE
WATERBORNE COMMERCE, CORPS OF ENGINEERS REPORT

	TOTAL TRAFFIC	IMPORTS	RECEIPTS	SHIPMENT	LOCAL SHIPMENT
Kerosene					
1971	341,346		276,777	64,569	
1970	281,711	26,198	203,415	47,853	4,245
1969	246,470		186,078	56,208	4,184
1968	325,679		262,805	62,260	614
1967	309,947		258,624	49,895	1,428
1966	271,697		214,596	56,390	711
Jet Fuel					
1971	32,832		32,832		
1970	111,598		69,218	42,380	
1969	58,975		58,975		
1968	37,775		35,308	2,467	
1967	19,137		19,137		
1966	9,688		9,688		

* In Tons

An analysis of the gasoline consumption through the Years 1966-1971 shows a constant normal fluctuation from 1967 through 1970. A 17% increase in quantity over 1970 was received in 1971 and the interim reports made to the Port indicate over 2,100,000 tons of gasoline were received in 1972. The current year 1973 has been reported by the distributors as maintaining a constant level of receipts acknowledging the same supply against an increase in demand.

The amount of #2 oil received shows a dramatic increase since 1966 indicating a greater demand for heating oil in the area. While admittedly influenced by weather conditions the amounts consumed are steadily increasing as conversion in home and utility heating facilities are made. Residual #6 oil has maintained the same level of growth as has #2 oil with high and low levels, but with constant growth over the six year study period. Preliminary reports of receipts for 1972 reflect a substantial increase due to the conversion of utilities and manufacturing plants from gas to oil.

Therefore, it can be ascertained on an historical approach that pertroleum volumes have maintained a substantial growth pattern in excess of 25% from 1966 through 1971.

For purposes of estimating future petroleum product demands, the following considerations were evaluated: Population growth, national per capita demand, historical trend, economic and petroleum industry forecasts.

The increase of future commerce in the Portland area will depend largely on the population increase in the market area. The area serviced by the Port includes all of Maine and the eastern sections of New Hampshire and Vermont. In 1960, the U.S. Bureau of the Census states that the national population growth would average more than two percent annually for the next 50 years. The Office of Business Economics, Department of Interior has projected the population growth in the State of Maine to increase by 2% per annum. Therefore, for purposes of forecasting, an average of 2% per year is being used for population growth.

The annual national per capita demand for petroleum in 1965 was 21.7 bbls. The annual national increase in per capita demand has been projected to 26.7 bbls. in the year 2000 and 32.0 bbls. in 2020. The per capita demand for New England increased from 25.6 bbls. in 1960 to 34.6 bbls. in 1970 with a projected increase to 36.8 bbls. in the year 2000 and 44.1 bbls. in the year 2020.

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This represents an average increase of 1.1 bbls. per year, 38% above the national average and an average growth rate of 5% per year.

Since most forecasts are made by the petroleum industry in 10-Year periods, we can only use these projections as a basis for long-term growth. The Oil and Gas Journal states that based on a national consumption of 15,870,000 barrels per day (B/D) in 1970, estimates indicate that in 1975 the demand should be 20,800,000 B/D and in 1980 will exceed 25,200,000 B/D. This represents a 30% growth in the period of 1970-1975 and a 25% increase through 1980.

The International Petroleum Encyclopedia reports that the demand in the 1973-1974 period will increase distillate consumption by 5.9% and residual oil consumption by 11.2%. The National Petroleum Council in a study projected U. S. petroleum demand will grow an annual average of 4.2% in the Years 1980-1985.

Shell Oil Company's 1972 report states that the average annual increase in petroleum demand during the next 3-Year period is predicted at 5.2% with the most dramatic increase coming in the current decade when the annual growth is expected to be 6.3%

Interviews with the terminal operators along Fore River reveal that although they are not involved in policy making decisions for the oil companies, they can nevertheless make a guarded forecast as to the demand anticipated for the area. In conversation, they related the fact that since all product was being restricted by quota to the previous year's recepts, the demand, if met, would exceed ten percent per year for the near future.

While not related to the area market study, the common pipeline and the new enlarged pier should result in a considerable increase in product handled by the Port due to the use of larger and more economical vessels. The considerable savings in freight should enable the oil companies to utilize the facilities for off-loading to smaller vessels or barges for delivery over an expanded service area. The total percentage of increase, therefore, is not possible to calculate at this time, but since off-loading *is now done in the area we can assume that* a substantial increase in traffic and receipts will occur.

3. Summary

Although all the basic data sources contacted were either vague or unable to project the demand past 1985, and acknowledging the various causes for uncertainty, several general conclusions can be drawn from the data accumulated.

- There will be an annual increase in petroleum demand in the area due to higher transportation and heating requirements.
- Greater industrial and utility needs due to the change in environmental restrictions require higher grade fuels.
- An improved receiving facility will allow for increased receipts and subsequent transshipments to other use areas resulting in freight savings.
- It is therefore projected that the future demand of petroleum products be determined as follows:

10%	increase	in 1973 and 1974
5%	"	in 1975 and 1976
4%	"	in 1977 and 1978
3%	"	thru 1979-2000
1.5%	"	2000 thru 2026

The foregoing projections have been used to calculate Table "B", pages 29, 30, and 31.

TABLE "B"

PRODUCT PROJECTION, PORTLAND, MAINE

YEAR	SHORT TONS 1,000 per yr.	7.1 bbls. PER SHORT TON 1,000 per yr.
1973	5,500	39,050
1974	6,050	42,955
1975	6,655	47,250
1976	6,987	49,613
1977	7,337	52,093
1978	7,630	54,177
1979	7,935	56,344
1980	8,173	58,034
1981	8,419	59,775
1982	8,671	61,569
1983	8,931	63,416
1984	9,199	65,318
1985	9,475	67,278
1986	9,760	69,296
1987	10,052	71,375
1988	10,354	73,516
1989	10,665	75,722
1990	10,985	77,993
1991	11,314	80,333
1992	11,654	82,743
1993	12,003	85,226

TABLE "B"

(Cont'd)

YEAR	SHORT TONS 1,000 per yr.	7.1 bbls. PER SHORT TON 1,000 per yr.
1994	12,363	87,782
1995	12,734	90,416
1996	13,116	93,128
1997	13,510	95,922
1998	13,915	98,800
1999	14,333	101,764
2000	14,762	104,817
2001	14,984	106,389
2002	15,209	107,985
2003	15,437	109,605
2004	15,668	111,249
2005	15,903	112,917
2006	16,142	114,611
2007	16,384	116,330
2008	16,630	118,075
2009	16,879	119,847
2010	17,133	121,644
2011	17,390	123,469
2012	17,650	125,321

TABLE "B" (Cont'd)

YEAR	SHORT TONS 1,000 per yr.	PER SHORT TON 1,000 per yr.
2013	17,915	127,201
2014	18,184	129,109
2015	18,457	131,045
2016	18,734	133,011
2017	19,015	135,006
2018	19,300	137,031
2019	19,589	139,087
2020	19,883	141,173
2021	20,181	143,291
2022	20,484	145,440
2023	20,791	147,622
2024	21,103	149,836
2025	21,420	152,084
2026	21,741	154,365

E. INNER HARBOR OIL TERMINAL SURVEY

The Fore River section of Portland Harbor is primarily a receiving and transshipment port for petroleum products. The Fore River consists of two sections, The outer-section extending from Diamond Island Roads to Portland Bridge, and the inner-section from Portland Bridge extending to the highway and Veteran's Memorial Bridge. This survey is basically concerned with the terminals based on the inner-harbor above Portland Bridge. The terminals inspected are all located on the South Portland side of the river.

The Portland Pipeline Company Pier No. 2 is located in the outer-harbor just south of the mouth of the Fore River. Their secondary Pier No. 1 is on the entrance to the Fore River around the bend. Since Portland Pipeline handles crude oil only for shipment to Canadian refineries, they are included in this survey only in the informative sense.

Since this report deals only with the requirements of existing oil product terminals, only such terminal facilities will be described.

1. Approximately 800 ft. downstream of Portland Pipeline Co. Pier No. 1 is the Chevron Oil Company dock. The wharf is timber pile, part concrete-decked. The outer end of the pier consists of two 35 foot diameter solid filled concrete capped caissons providing a 275 foot berthing face with an additional 225 feet of berthing at the rear face for small tankers and barges. Three pipelines extend to a tank farm with a storage capacity of 840,000 barrels.

2. The next oil terminal upstream is the Texaco, Inc. wharf located approximately 1/3 of a mile above Portland Bridge. The wharf is an L-shaped pier of timber pile and timber deck construction with an offshore pipeline trestle extension 1097 feet long by 20 feet wide. Steel pile, concrete topped mooring dolphins are in line with the face of the extended portion. A considerable amount of money has recently been spent to modernize and update this facility. Six pipelines connect the wharf to a tank farm with a total capacity of 800,000 barrels.

3. The American Oil Company wharf is located approximately one mile above the Portland Bridge. The wharf is timber pile with a 300 x 8-foot catwalk and pipeline trestle fronted on each side by five (5) breasting

dolphins. Five pipelines connect the pier with the storage area having holding capacity of 500,000 barrels.

4. Continuing upstream, is the Mobil Oil Company pier, constructed of steel pile, having a length of 335 feet and a width of 15 feet. The deck of this structure is part timber and part concrete, The wharf has a 220 foot berthing space, connected by nine pipelines to an adjacent tank farm with a total capacity of 800,000 barrels. Four additional pipelines extend from the pier to the Northeast Oil Co. storage area. Mobil Oil Company owns and operates a six-inch pipeline to Bangor, Maine which is used by other distributors on a through-put charge. The pier is also utilized by Northeast Petroleum Corp. and Citgo Oil Co.

5. Northeast Petroleum Company operates the next pier upstream. This terminal receives and ships product in small tankers and barges. The wharf is of wood-pile and timber construction. It has a usable berthing space 160 ft. long. The storage tanks connected by 4-6 inch lines have a total capacity of 180,000 barrels.

6. The next pier is the Bancroft and Martin "T" dock.

This terminal is used by Getty Oil Company, Shell Oil Company and British Petroleum Company. The wharf is a timber pile, timber-decked offshore pier 75 feet long by 10 feet wide with a usable berthing space of 150 feet in length. Eleven pipelines connect the pier to the various terminals.

7. The last wharf in Fore River is the Bancroft and Martin "L" Dock. Gulf Oil Company, Getty Oil Company, Shell Oil Company and Exxon Oil Co cooperatively rent and operate this pier. The pier is part timber and steel pile with a part timber and concrete deck. The offshore wharf has a catwalk and pipeline trestle with an angular-shaped approach. Usable berthing space on the face is 420 feet long and the rear face has space for berthing 114 feet long. Pipelines run throughout the area connecting the wharf with the terminals. The tank farms have the following capacities: Gulf-600,000 barrels, Getty-500,000 barrels, Shell-500,000 barrels, and Exxon-800,000 barrels.

Table "C", page 36 reflects the storage and product percentage inventory of the above oil terminals.

TABLE "C"
PORTLAND, MAINE
STORAGE AND PRODUCT PERCENTAGE INVENTORY (bbls)

	PREM (x1000)	REG (x1000)	UNLED (x1000)	GAS %	#2 %	#2 Diesel	kero. DIST %	#6 %	Jet	STORAGE CAPACITY bbls.	
√ Getty ☆	111	–	41	50 TOT: 142,000	45 142,000	–	5 5,000	– –	–	500,000 289,000	
√ Northeast Pet.	–	–	–	50 –	45 160,000	–	5 25,000	–	–	180,000 185,000	
√ Mobil	28	170	60	40 TOT=258,000	50 238,000	–	10 114,000	small –	– 135,000	800,000 745,000	
√ Exxon	62	54	30	50 TOT: 146,000	40 546,000	– 30,000	10 161,000	– –	– 6,000	800,000 889,000	
√ B. P. (Now owned by GIBBS)				70	27		3	–		250,000	
√ American Oil Co. (Storage on L.I. 480,000 bbls.)				50 140,000	35 190,000		5	10 155,000	–	500,000 485,000	
√ Texaco				17	17		11	55		800,000	
Gulf				50	45		5	–		600,000	
√ Chevron ☆				30 170,000	28 242,000		2 80,000	40 192,000	–	840,000 684,000	(+192,000 NE Pet. Lease = 876,000)
Shell										500,000	
Sun (Bock Bay)				50	40		10	–		100,000	
										5,870,000	

EXISTING CONDITIONS & OPERATIONS

There are ten (10) oil terminals using seven (7) piers on Fore River, with a storage capacity of 5,870,000 barrels. It has been estimated that in the immediate area there is at most 10% more room for expansion. Nine (9) companies are located upstream above the Portland Bridge.

The Chevron Oil Co. at the mouth of the river is the only terminal that is unaffected by the limitations of the bridge or width of the channel. The only restrictions to the size of tankers calling at Chevron is the present 35-foot water depth and the size of the wharf.

The size of tankers, which can service the remaining nine (9) terminals, is limited by the width restriction imposed by Portland Bridge. The horizontal clearance between the bridge fenders is 98 feet, and it is reported that vessels having width in excess of 95 feet pass through this opening subject to tanker superstructure clearing bascule leaves. Terminal facilities, channel depth, and maneuvering area further limit the size of vessels transiting above the bridge.

One common conflict which arises when a vessel requires passage through Portland Bridge is the necessity to disrupt the flow of vehicular traffic when the bridge is opened. This conflict is most serious during the morning and evening rush hours and results in considerable public complaint and discomfort.

At present, tanker traffic requires careful scheduling to prevent congestion at the respective piers shared by the oil companies. Due to the inability to use larger and more economical tankers, more ships than necessary are required to service the requirements of the terminals. Even though terminal operators cooperate in scheduling vessel movements, vessel delays are frequent and expensive.

Recent regulations have been passed by government agencies requiring the booming of tankers at all the piers. These efforts are undertaken by local interests at considerable operating and maintenance expense.

The survey of the Port strongly suggests that an alternative scheme of receiving products to the terminals be developed to overcome the present restrictions in Fore River. Suggestions and studies have been made to replace Portland Bridge with a new vehicular bridge having a higher and longer span, to construct a tunnel under the river, and to dredge the channel. It is the consultants' recommendation that neither of these alternatives are economically feasible or publicly acceptable.

F. COMMON PIPELINE SYSTEM

1. System Criteria

The requirements for a common pipeline system and a marine terminal berth were based on the present and projected demand for petroleum products at Portland Harbor.

The design criteria of the receiving berths were established considering optimum tanker size and were based on the economy of transportation, delivery of required throughputs, access to the harbor and berths in the existing available depth of the channel, effects of weather and tides on berth occupancy and also ease of navigation in the available channel ways.

The design criterion for the pipelines leading to the intermediate storage tank farm was the offloading maximum rate of the optimum size tanker pumps. The criterion for the storage capacity of the intermediate storage tank farm was allowance for the difference of flow between inflow and outflow resulting from accumulation of tankers after a five-day port closure due to adverse weather conditions. Although this condition has never occurred, a five day port closure period is assumed for design purposes. The design criterion for the distribution lines to the receiving terminals and their tank farms was a provision of the present and future flow of products based on the annual throughput.

2. Inshore Receiving Terminal-Alternative "A"

a. System Development

The development of the inshore oil product receiving terminal system, shown in Figure 2, is proposed in two stages. The initial stage presents a products unloading facility located in Fore River at Pier No. 1 presently owned by the Portland Pipeline Company. It assumes modification of the existing facility to accommodate a 30,000 DWT average size tanker which is required to deliver a projected annual throughput of products equal to 12.7 million tons up to the Year 1995. The first leg of the common pipeline, originating from the loading platform of the pier, would be connected to a tank farm by three pipelines which will individually deliver three types of products, namely residual oil, distillates and gasoline.

The tank farm will initially consist of three intermediate storage tanks, each with a capacity of 230,000 barrels. It will be capable of holding the difference between product inflow and outflow resulting from the accumulation of tankers during a five-day port closure.

From the intermediate storage tank farm a pumping station will deliver the products separately by three distribution lines to the existing individually owned tank farms located along the south bank of Fore River. The pipeline sizes will be reduced along the route according to the demand of flow by the individual users.

The distribution lines will be capable of transferring the projected annual throughput flow of 21.7 million tons in the Year 2026.

The demand for petroleum products beyond 1995 will require a second stage development consisting of a new 50,000 DWT average size tanker terminal, the addition of five 230,000 bbl. storage tanks, expansion of the pumping station, and a new pipeline system to connect the new terminal with the expanded tank farm. The staging and products flow is graphically represented in Figure 5.

It should be noted that the delivery lines from tanker berths to the storage farm are larger than the distribution lines. The reason is that the product flow in the distribution lines is based on a 24-hour-a-day operation and therefore of lesser flow rate, whereas the flow in the pipelines to the tank farms is based on the ability of the ship to deliver the flow in much shorter time; i.e., at the pumping rate of the ship's pumps, to permit the vessel to turn around as quickly as possible.

A study of berth occupancy factors for the products receiving terminal in the initial stage indicates that a two-berth pier would be needed as evidenced by "Berth Occupancy Ratio", Figure 13.

In the earlier years of operation, there would be a higher number of smaller sized vessels using the products terminal. As the growth in delivered tonnage occurs, the oil companies would be converting to larger vessels for delivering their products. The result would be that the berth occupancy would remain relatively constant because the growth in tonnage would be handled by larger vessels.

To reduce ship waiting time, however, in the event a large number of small tankers should arrive at the same time, or if unforeseen circumstances make it difficult for smaller vessels to use the proposed berths, the nearby Chevron Pier conceivably could be tied into the system for emergency use.

The pipeline location shown in Figure 2 follows an approximate route which has been selected to minimize right-of-way and land acquisition costs. It will run nea the river bank away from main traffic arteries to avoid interference with road traffic, traffic delays due to construction, and the associated high construction costs usually encountered in congested urban areas. Crossing of some limited numbers of streets, however, will be necessary especially the access road leading to Portland Bridge which crosses the pipeline route.

The above described 2-stage construction provides for terminal development in which the initial proposed phase is the most economically feasible, requiring minimum initial capital investment. Cost estimates for this alternative, broken down by major items, are given in Section "G".

b. <u>Berthing Facilities</u>

The existing Pier No. 1, approximately 890 feet long, and located at the entrance of Fore River at the foot of Stanford Street is presently used for receipt of crude oil by Portland Pipeline Corporation. It consists of four steel sheet-pile, solid filled, concrete-capped cells with a connecting 10 foot wide timber catwalk. The three outer cells have timber fendering.

Located between the 2nd and 3rd cells is a concrete-decked loading platform, 30 feet wide and 90 feet long, supported by steel piles. One 10-ton electric, fixed revolving crane with a 60-foot boom is located on the platform for handling hoses.

The pier utilities include one 6-inch water supply line with 2-1/2 inch hose connections, a foam fire protection system, hydrants, and hose and hand extinguishers.

One 16-inch and one 24-inch diameter pipelines extend from the loading platform and connect with two crude oil storage tanks with total storage capacity of 280,000 barrels.

Based on information received from the owners, the pier was originally designed for 22,000 to 24,000 DWT vessels. To be capable of accommodating larger vessels up to 35,000 DWT, the pier will require modification. For this purpose, in the initial Alternative "A" Stage, allowance is made for installation of four new breasting dolphins, two on each side of the pier, and reinforcement of existing mooring facilites. Also, additional allowance is made for modification of the existing loading platform consisting of a set of new articulated counter-balanced loading units,shown in Figure 10, and a new pipeline network and mechanical and electrical instrumentation. Other items to be provided for control of fire and containment of oil spills are a fire fighting system adequate to handle fire at dockside and shipboard emergencies, plus an oily-water waste system mounted under the platform. For further prevention of pollution due to unconfined oil spillage, which most likely would occur in the space between the ship and the pier near the loading platform, a floating oil boom (skirt type floating barrier) will be provided. The boom will be capable of containing oil spills within the periphery of the boom and thereby prevent contamination of the outside waters.

The basic configuration of the 50,000 DWT tanker berth in the second stage, namely the expansion stage, contained in Alternative "A" is shown in Figure 2 and 8. It consists of four breasting dolphins, two on each side of the pier, with a fendering system to absorb ship impact during berthing. The spacing of the dolphins will be such as to allow for the berthing of tankers in the applicable range.

Between these dolphins, a central loading platform will carry two sets of articulated counter-balanced loading units; a set being located on each side of the platform. In addition to the required piping, metering devices and electrical instrumentation, the platform will be curbed and equipped with fire-fighting and pollution control equipment similarly as described above for modification of Pier No. 1 and as shown in Figure 10.

Four mooring dolphins, located along the longitudinal axis of the pier will provide the necessary anchorage for staying of vessels at berth.

The berthing and mooring dolphins will be equipped with quick release hook and capstan assemblies capable to withstand components of vertical and horizontal ships' line pull. The mooring and breasting dolphins will be interconnected by catwalks to provide easy access by personnel handling the mooring lines.

An approach trestle will connect the loading platform to shore, carrying the three product pipelines over the water to shore.

As was the case with Pier No. 1, this pier will be equipped with three sections of oil booms. One permanently deployed along the longitudinal axis of the pier and two portable boom sections to be deployed around a vessel after berthing at the pier. Each portable boom section will enclose the tanker at berth, and with the central section will form a continuous barrier encirlcing each vessel.

3. Inshore Receiving Terminal-Alternative "B"

a. System Development

The development of this inshore oil products receiving system, shown in Figure 3 and 8, is proposed in one stage. It is basically the same as the expanded system in Alternative "A". It eliminates, however, the use of Pier No. 1 and the connecting pipelines between the loading platform and the tank farm. In this alternative the entire facility is designed to accommodate the flow of oil products as dictated by the present throughput requirements and those projected for the Year 2026. The products flow is graphically represented in Figure 6.

The reasoning in implementing this scheme is that it offers an alternative choice of contructing a 50,000 DWT average size tanker berth in the event that acquisition of Pier No. 1 is not possible. Also, if the demand for products exceeds projections well before 1995, the 50,000 DWT berth would be required.

The cost estimated for this common pipeline system, broken down by major items, are given in Section "G".

b. Berthing Facilities

The 50,000 DWT tanker berthing facility is the same as described under Berthing Facilities for second stage of development in Alternative "A".

4. Offshore Receiving Terminal-Alternative "C"

a. System Development

For evaluation of the feasibility of this alternative, the common pipeline system is based on a single-phase construction of the entire facility, although alternative phases, initial and expanded, could be applied here as in Alternative "A".

Cliff Island has been chosen as the most feasible location due to its ease of navigation and minor environmental impact ensuing thereto.

The development of an offshore oil products receiving terminal, shown in Figure 4 is proposed in one stage. This system consists of a two-berth 100,000 DWT tanker terminal located off the west side of Cliff Island connected to an intermediate storage tank farm on Long Island by means of three submarine lines, approximately 6000 feet long, and land lines approximately 8,000 feet long. The existing terminals located along the south bank of Fore River in South Portland would be connected to the tank farm by three distribution lines consisting of main trunk submarine lines approximately 19,000 feet long and land lines approximately 24,000 feet long. The pipeline extensions off the main trunk lines will be reduced in size according to the flow demand of the individual users tank farm.

In developing the required intermediate storage tank farm with a total capacity of 3,450,000 bbl., utilization has been made of the six existing fuel, diesel, and motor fuel storage tanks, located on Long Island having a combined capacity of approximately 600,000 bbl. The remaining 2,850,000 bbl. of required storage will be provided by constructing nine additional 320,000 bbl. storage tanks. Similar to alternative "A" and "B", the tank farm will be capable of holding the difference between products inflow and outflow resulting from accumulation of tankers over a five-day port closure period.

A pumping station located in Long Island will deliver the products in separate lines to the individual users. The routing of delivered products to the individual terminals along the pipeline system would be accomplished by means of automated switches and valves which would be operated from a control house in the tank farm area. Information concerning the available tank farm storage and operations at each terminal will be provided on a control panel system.

Alternative "C" offers an alternative choice of construction of 100,000 DWT tanker berth in the event that the land acreage required for construction of the tank farm in either of the preceding Alternatives "A" and "B" cannot be acquired. The same may apply to waterfront areas required for construction of the 50,000 DWT terminal.

Although the capital investment required for Alternative "C" system is almost double the expanded facility in Alternative "A" and the single-phase facility in Alternative "B", there are many advantages, some of which are:

1. The Long Island property, presently owned by King Resources Company, has approximately 145 acres of land which is now in progress of rezoning for an oil receiving facility.

2. Traffic in the approach channel to Portland Harbor and Fore River is relieved.

3. Tank farm and piers are relocated from highly congested neighborhoods.

4. The handling of large vessels and barge, for transshipmentto Boston and other areas of New England is made possible.

5. There is potential for utilization as a combined products-crude oil receiving terminal.

6. The terminal facility located in one of the few <u>desirable</u> areas that could receive very large tankers.

7. The right-of-way required for the pipelines connecting the pier to the proposed tank farm in Long Island should pose little difficulty since much of the pipeline is buried in Luckse Sound with the remaining land lines buried along the shore of the island.

b. <u>Berthing Facilities</u>

The 100,000 DWT tanker berth shown in Figure 9 is similar to the 50,000 DWT berth described in Alternatives "A" and "B". The components of the terminal, breasting and mooring dolphins, loading platform, etc., however, will be of larger sizes resulting from the requirement to accommodate larger impact forces and construction of foundations in deeper water. In addition, allowances must be made for greater forces due to wave and wind action and also the requirement dictated by larger throughput volume resulting in heavier pipe loads.

G. <u>COST ESTIMATES</u>

Alternative A

Alternative B

Alternative C

ALTERNATIVE NO. A DESCRIPTION INSHORE RECEIVING TERMINAL SHEET 1 OF 3

ITEM	UNIT	UNIT PRICE	INITIAL FACILITY: 250 MB/D REQUIRED THROUGHPUT; 250 MB/D PROVIDED BY 30,000 DWT AVERAGE TANKER — QUANTITY	INITIAL FACILITY — COST (1000 $)	EXPANDED FACILITY: 420 MB/D REQUIRED THROUGHPUT; 420 MB/D PROVIDED BY 50,000 DWT AVERAGE TANKER — QUANTITY	EXPANDED FACILITY — COST (1000 $)	INITIAL & EXPANDED FACILITY: 420 MB/D MAX. THROUGHPUT — TOTAL COST (1000 $)
I CAPITAL INVESTMENT							
1. MODIFICATION OF (2) BERTHS FOR							
PORTLAND PIPELINE PIER #1							
FOR 30,000 DWT AVERAGE							
TANKER (35' DEPTH)							
A. STRUCTURE	-	L.S.		1,580	-	-	1,580
B. MECHANICAL	-	L.S.		820	-	-	820
C. ELECTRICAL	-	L.S.		200	-	-	200
D. DREDGING	CY	5.00	50,000	250	-	-	250
E. OIL BOOM, ETC.	LF	30.00	3,000	90	-	-	90
F. PURCHASE OF PIER	-	L.S.		500	-	-	500
2. FIXED PIER (2) BERTHS FOR							
50,000 DWT TANKER (45' DEPTH)							
A. STRUCTURE	-	L.S.	-	-		3,740	3,740
B. MECHANICAL	-	L.S.	-	-		1,520	1,520
C. ELECTRICAL	-	L.S.	-	-		600	600
D. DREDGING	CY	4.00	-	-	1,600,000	6,400	6,400
E. OIL BOOM, ETC.	LF	30.00	-	-	4,000	120	120
3. 1. LAND PIPELINES							
RESIDUAL OIL LINE 24" DIA.	LF	70.00	3,000	210	-	-	210
DISTILLATE LINE 24" DIA.	LF	70.00	3,000	210	-	-	210
MOTOR FUEL LINE 18" DIA.	LF	60.00	3,000	180	-	-	180
3. 2. LAND PIPELINES							
RESIDUAL OIL LINE 30" DIA.	LF	80.00	-	-	3,600	288	288
DISTILLATE LINE 30" DIA.	LF	80.00	-	-	3,600	288	288
MOTOR FUEL LINE 24" DIA.	LF	70.00	-	-	3,600	252	252
SUBTOTAL				4,040		13,208	17,248

ALTERNATIVE NO. A DESCRIPTION INSHORE RECEIVING TERMINAL SHEET 2 OF 3

ITEM	UNIT	UNIT PRICE	INITIAL FACILITY: 250 MB/D REQUIRED THROUGHPUT; 250 MB/D PROVIDED BY 30,000 DWT AVERAGE TANKER — QUANTITY	INITIAL FACILITY — COST (1000 $)	EXPANDED FACILITY: 420 MB/D REQUIRED THROUGHPUT; 420 MB/D PROVIDED BY 50,000 DWT AVERAGE TANKER — QUANTITY	EXPANDED FACILITY — COST (1000 $)	INITIAL & EXPANDED FACILITY: 420 MB/D MAX. THROUGHPUT — TOTAL COST (1000 $)
(BROUGHT FORWARD)				4,040		13,208	17,248
4. TANK FARM							
RESIDUAL OIL TANKS	BBL	2.50	230,000	575	230,000	575	1,150
DISTILLATE TANKS	BBL	2.50	230,000	575	460,000	1,150	1,725
MOTOR FUEL TANKS	BBL	2.50	230,000	575	460,000	1,150	1,725
PIPING	BBL	0.25	690,000	173	1,150,000	288	461
ELECTRICAL	BBL	0.25	690,000	173	1,150,000	288	461
DIKES, ROADS, ETC.	BBL	0.40	690,000	276	1,150,000	460	736
POLLUTION PROTECTION SYSTEM	BBL	0.10	690,000	69	1,150,000	115	184
LAND AND DEVELOPMENT	ACRE	100,000	11	1,100	11	1,100	2,200
ACCESS ROADS	MILE	200,000	0.3	60	0.3	60	120
5. PUMP STATION							
PUMPS & DRIVERS, ETC.	HP	180	1,100	198	2,100	378	576
REMOTE CONTROLS SYSTEM	-	LS		250		300	550
6. LAUNCH	EA.	100,000	1	100	1	100	200
7. SUPPORT FACILITIES							
OFFICE BUILDING	-	LS		30		40	70
MAINTENANCE SHOP		LS		60		50	110
WAREHOUSE		LS		30		40	70
COMMUNICATION FACILITY		LS		30		40	70
8. DISTRIBUTION LINES							
A. MAIN TRUNK TO TEXACO							
RESIDUAL OIL LINE 14" DIA	LF	60	14,400	864	-	-	864
DISTILLATE LINE 14" DIA	LF	60	14,400	864	-	-	864
MOTOR FUEL LINE 14" DIA	LF	60	14,400	864	-	-	864
B. EXTENSION OF TRUNK TO AMOCO							
RESIDUAL OIL LINE 8" DIA	LF	45	2,400	108	-	-	108
DISTILLATE LINE 14" DIA	LF	60	2,400	144	-	-	144
MOTOR FUEL LINE 12" DIA	LF	55	2,400	132	-	-	132
SUBTOTAL				11,290		19,342	30,632

ALTERNATIVE NO. A   DESCRIPTION INSHORE RECEIVING TERMINAL   SHEET 3 OF 3

ITEM	UNIT	UNIT PRICE	INITIAL FACILITY: 250 MB/D REQUIRED THROUGHPUT; 250 MB/D PROVIDED BY 30,000 DWT AVERAGE TANKER		EXPANDED FACILITY: 420 MB/D REQUIRED THROUGHPUT; 420 MB/D PROVIDED BY 50,000 DWT AVERAGE TANKER		INITIAL & EXPANDED FACILITY: 420 MB/D MAX. THROUGHPUT
			QUANTITY	COST (1000 $)	QUANTITY	COST (1000 $)	TOTAL COST (1000 $)
(BROUGHT FORWARD)				11,290		19,342	30,632
8. C. END SECTION OF TRUNK							
TO OTHER USERS							
RESIDUAL OIL LINE ✓ 8" DIA.	LF	45	1,500	68	-	-	68
DISTILLATE LINE ✓ 12" DIA.	LF	55	1,500	83	-	-	83
MOTOR FUEL LINE ✓ 10" DIA	LF	50	1,500	75	-	-	75
R.O.W. (TOTAL A,B,C & 3.1)	MILE	20,000	3.5	70	0.6	12	82
CAPITAL INVESTMENT TOTAL				11,586		19,354	30,940

ALTERNATIVE NO. B DESCRIPTION INSHORE RECEIVING TERMINAL SHEET 1 OF 2

ITEM	UNIT	UNIT PRICE	INITIAL FACILITY: 420 MB/D REQUIRED THROUGHPUT; 420 MB/D PROVIDED BY 50,000 DWT AVERAGE TANKER — QUANTITY	INITIAL FACILITY — COST (1000 $)	EXPANDED FACILITY: MB/D REQUIRED THROUGHPUT; MB/D PROVIDED BY DWT AVERAGE TANKER — QUANTITY	EXPANDED FACILITY — COST (1000 $)	INITIAL & EXPANDED FACILITY: MB/D MAX. THROUGHPUT — TOTAL COST (1000 $)
I CAPITAL INVESTMENT							
1. FIXED PIER (2) BERTHS FOR							
50,000 DWT TANKER (45' DEPTH)							
A. STRUCTURE	-	L.S.		3,740			
B. MECHANICAL	-	L.S.		1,520			
C. ELECTRICAL	-			600			
D. DREDGING	CY.	4.00	1,600,000	6,400			
E. OIL BOOM, ETC.	LF	30	4,000	120	12,380		
2. LAND PIPELINES							
RESIDUAL OIL LINE 30" DIA.	L.F.	80	3,600	280			
DISTILLATE LINE 30" DIA	L.F.	80	3,600	280			
MOTOR FUEL LINE 24" DIA.	L.F.	70	3,600	252	810		
3. TANK FARM							
RESIDUAL OIL TANKS	BBL	2.50	460,000	1,150			
DISTILLATE TANKS	BBL	2.50	690,000	1,725			
MOTOR FUEL TANKS	BBL	2.50	690,000	1,725			
PIPING	BBL	0.25	1,840,000	460			
ELECTRICAL	BBL	0.25	1,840,000	460			
DIKES, ROADS, ETC.	BBL	0.40	1,840,000	736			
POLLUTION PROTECTION SYSTEM	BBL	0.10	1,840,000	184			
LAND AND DEVELOPMENT	ACRE	100,000	22	2,200			
ACCESS ROADS	MILE	200,000	0.5	100			
				6740			
4. PUMP STATION							
PUMPS & DRIVERS, ETC.	H.P.	180	3,200	576	1,076		
REMOTE CONTROLS SYSTEMS	-	L.S.	500	500			
					100		
5. LAUNCH	EA.	100,000	1	100	14366		
SUBTOTAL				23,108			

ALTERNATIVE NO. 8 DESCRIPTION INSHORE RECEIVING TERMINAL SHEET 2 OF 2

ITEM	UNIT	UNIT PRICE	INITIAL FACILITY: 420 MB/D REQUIRED THROUGHPUT; 420 MB/D PROVIDED BY 50,000 DWT AVERAGE TANKER — QUANTITY	INITIAL FACILITY — COST (1000 $)	EXPANDED FACILITY: ___ MB/D REQUIRED THROUGHPUT; ___ MB/D PROVIDED BY ___ DWT AVERAGE TANKER — QUANTITY	EXPANDED FACILITY — COST (1000 $)	INITIAL & EXPANDED FACILITY: ___ MB/D MAX. THROUGHPUT — TOTAL COST (1000 $)
1 (BROUGHT FORWARD)				23,108			
6. SUPPORT FACILITIES							
OFFICE BUILDING		L.S.		50			
MAINTENANCE SHOP		L.S.		100			
WAREHOUSE		L.S.		50			
COMMUNICATION FACILITY		L.S.		50			
7. DISTRIBUTION LINES							
A. MAIN TRUNK TO TEXACO							
RESIDUAL OIL LINE ✓14" DIA.	L.F.	60	14,400	864			
DISTILLATE LINE ✓14" DIA.	L.F.	60	14,400	864			
MOTOR FUEL LINE ✓14" DIA.	L.F.	60	14,400	864			
B. EXTENSION OF TRUNK TO AMOCO							
RESIDUAL OIL LINE ✓8" DIA.	L.F.	45	2,400	108			
DISTILLATE LINE ✓14" DIA.	L.F.	60	2,400	144			
MOTOR FUEL LINE ✓12" DIA.	L.F.	55	2,400	132			
C. END SECTION OF TRUNK							
TO OTHER USERS							
RESIDUAL OIL LINES ✓8" DIA.	L.F.	45	1,500	68			
DISTILLATE LINE ✓12" DIA.	L.F.	55	1,500	83			
MOTOR FUEL LINE ✓10" DIA.	L.F.	50	1,500	75			
R.O.W. (TOTAL A,B,C)	MILES	20,000	3.5	70			
CAPITAL INVESTMENT TOTAL				26,630			

ALTERNATIVE NO. C DESCRIPTION OFFSHORE RECEIVING TERMINAL SHEET 1 OF 3

ITEM		UNIT	UNIT PRICE	INITIAL FACILITY: 420 MB/D REQUIRED THROUGHPUT; 420 MB/D PROVIDED BY 100,000 DWT AVERAGE TANKER — QUANTITY	INITIAL FACILITY — COST (1000 $)	EXPANDED FACILITY: ___ MB/D REQUIRED THROUGHPUT; ___ MB/D PROVIDED BY ___ DWT AVERAGE TANKER — QUANTITY	EXPANDED FACILITY — COST (1000 $)	INITIAL & EXPANDED FACILITY: ___ MB/D MAX. THROUGHPUT — TOTAL COST (1000 $)
I CAPITAL INVESTMENT								
1. FIXED PIER (2) BERTHS FOR 100,000 DWT TANKER (60' DEPTH)								
A. STRUCTURE		-	L.S.		7,300			
B. MECHANICAL					2,620			
C. ELECTRICAL					1,320			
D. OIL BOOM, ETC.		L.F.	30	5,000	150			
2. SUBMARINE LINES								
RESIDUAL OIL LINE	38" DIA.	L.F.	245	6,000	1,470			
DISTILLATE LINE	38" DIA.	L.F.	245	6,000	1,470			
MOTOR FUEL LINE	34" DIA.	L.F.	235	6,000	1,410			
3. LAND LINES								
RESIDUAL OIL LINE	38" DIA.	L.F.	90	8,000	720			
DISTILLATE LINE	38" DIA.	L.F.	90	8,000	720			
MOTOR FUEL LINE	34" DIA.	L.F.	80	8,000	640			
4. TANK FARM								
MODIFY EXIST. FUEL OIL TANKS		BBL	0.30	475,000	143			
MODIFY EXIST. DIESEL OIL TANKS		BBL	0.40	115,000	46			
MODIFY EXIST. MOTOR FUEL TANKS		GAL.	0.10	300,000	30			
NEW RESIDUAL OIL TANKS		BBL	2.50	675,000	1,688			
NEW DISTILLATE TANKS		BBL	2.50	1,035,000	2,588			
NEW MOTOR FUEL TANKS		BBL	2.50	1,145,000	2,863			
SUBTOTAL					25,158			

ALTERNATIVE NO. C DESCRIPTION OFFSHORE RECEIVING TERMINAL SHEET 2 OF 3

ITEM	UNIT	UNIT PRICE	INITIAL FACILITY: 420 MB/D REQUIRED THROUGHPUT; 420 MB/D PROVIDED BY 100,000 DWT AVERAGE TANKER — QUANTITY	INITIAL FACILITY — COST (1000 $)	EXPANDED FACILITY: ___ MB/D REQUIRED THROUGHPUT; ___ MB/D PROVIDED BY ___ DWT AVERAGE TANKER — QUANTITY	EXPANDED FACILITY — COST (1000 $)	INITIAL & EXPANDED FACILITY: ___ MB/D MAX. THROUGHPUT — TOTAL COST (1000 $)
(BROUGHT FORWARD)				25,158			
4. TANK FARM (CONTINUED)							
PIPING	BBL	0.25	2,860,000	715			
DIKES & ROADS, ETC.	BBL	0.40	2,860,000	1,144			
POLLUTION PROTECTION SYSTEM	BBL	0.10	2,860,000	286			
PURCHASE OF LAND AND							
EXISTING TANK FARM	-	L.S.		3,000			
DEVELOPMENT OF ADDL. LAND	ACRE	2,000	50	100			
ACCESS ROADS	MILE	1	200,000	200			
5. PUMP STATION							
PUMPS AND DRIVERS, ETC.	H.P.	180	6,500	1,170			
REMOTE CONTROLS SYSTEMS	-	L.S.		500			
6. LAUNCH	EA.	100,000	2	200			
7. SUPPORT FACILITIES, ETC.							
(INCLUDED IN ITEM 4)	-	-	-	-			
COMMUNICATION FACILITY	-	L.S.		40			
8. DISTRIBUTION LINES							
A. SUBMARINE LINE							
MAIN TRUNK TO CHEVRON							
RESIDUAL OIL LINE 30" DIA.	L.F.	225	14,000	3,150			
DISTILLATE LINE 30" DIA.	L.F.	225	14,000	3,150			
MOTOR FUEL 26" DIA	L.F.	215	14,000	3,010			
B. LAND LINE							
MAIN TRUNK TO CHEVRON							
RESIDUAL OIL LINE 30" DIA	L.F.	90	10,000	900			
DISTILLATE LINE 30" DIA	L.F.	90	10,000	900			
MOTOR FUEL LINE 26" DIA	L.F.	75	10,000	750			
SUBTOTAL				44,373			

ALTERNATIVE NO. C DESCRIPTION OFFSHORE RECEIVING TERMINAL SHEET 3 OF 3

ITEM	UNIT	UNIT PRICE	INITIAL FACILITY: 420 MB/D REQUIRED THROUGHPUT; 420 MB/D PROVIDED BY 100,000 DWT AVERAGE TANKER — QUANTITY	INITIAL FACILITY — COST (1000 $)	EXPANDED FACILITY: ___ MB/D REQUIRED THROUGHPUT; ___ MB/D PROVIDED BY ___ DWT AVERAGE TANKER — QUANTITY	EXPANDED FACILITY — COST (1000 $)	INITIAL & EXPANDED FACILITY: ___ MB/D MAX. THROUGHPUT — TOTAL COST (1000 $)
(BROUGHT FORWARD)				44,373			
8. C. LAND LINE							
EXTENSION OF TRUNK LINES							
FROM CHEVRON TO TEXACO							
RESIDUAL OIL LINE 24" DIA.	L.F.	70	14,000	980			
DISTILLATE LINE 24" DIA.	L.F.	70	14,000	980			
MOTOR FUEL 24" DIA.	L.F.	70	14,000	980			
D. LAND LINE							
EXTENSION OF TRUNK LINES							
FROM TEXACO TO AMOCO							
RESIDUAL OIL LINE 10" DIA.	L.F.	50	2,400	120			
DISTILLATE LINE 24" DIA.	L.F.	70	2,400	168			
MOTOR FUEL LINE 20" DIA.	L.F.	65	2,400	156			
E. LAND LINE							
EXTENSION OF TRUNK LINES							
FROM AMOCO TO OTHERS							
RESIDUAL OIL LINE 10" DIA.	L.F.	50	1,500	75			
DISTILLATE LINE 16" DIA.	L.F.	60	1,500	90			
MOTOR FUEL LINE 12" DIA.	L.F.	55	1,500	83			
R.O.W. (TOTAL A,B,C)	MILES	10,000	5.5	55			
CAPITAL INVESTMENT TOTAL				48,060			

H. ECONOMIC ANALYSIS

The estimated projection of petroleum products having been determined by the market survey, it is therefore possible to create an economic evaluation of the three alternative schemes proposed by this report.

In order to maintain a constant basis for financial analysis the following assumptions have been made:

Income has been derived from the projected throughputs of product at an arbitrary rate of $.60 per ton. This amount was determined by the prospective freight savings or the amount necessary to break even with the Alternative Scheme "A" Expanded and Alternative "B". The projected revenues can therefore be adjusted to the desired schemes by the increase in volumes or additional increase or reduction in the throughput charge.

Operating expense has been determined by calculating the personnel necessary to operate the terminal and pipeline by the average wage-scale of $15,000 per year. In determining the annual increases in labor costs we have averaged the increase to 5% per year based on government guidelines and cost of living indexes.

TABLE "D"

SUMMARY OF ANNUAL OPERATING AND MAINTENANCE COSTS

COST ITEM	ALTERNATIVE A INITIAL 250M B/D	ALTERNATIVE A EXPANDED 420M B/D	ALTERNATIVE B 420M B/D	ALTERNATIVE C 420M B/D
MARINE TERMINAL	($1000)	($1000)	($1000)	($1000)
Staff	$150	$150	$150	$150
Launches & Work Boats	25	25	25	50
Maintenance	36	174	136	114
Sub-Total	$211	$349	$311	$314
TANK FARM & PIPELINE				
Staff	$135	$135	$135	$135
Transportation	25	25	25	50
Maintenance	151	277	304	333
Sub-Total	$311	$437	$464	$518
TOTAL	$522	$786	$775	$832

ASSUMPTIONS:

Marine Terminal Personnel - Two (2) Berths: 1-Dockmaster, 2 Foreman, 6 Dockworkers, 1-Administrative
10 Total @ $15,000 assumed

Tank Farm Personnel: 1-Superintendent, 1-Foreman, 6-Laborers, 1-Administrative
9 Total @ $15,000 assumed

Marine Terminal Maintenance Cost calculated at 1% of construction cost, plus 10% contingency.

Tank Farm and Pipeline Maintenance Cost determined as 2% of construction cost, plus 10% for contingency. Alternative "C" adjusted due to submarine pipeline not requiring maintenance in proportion to system.

Maintenance is determined by the straight line method although maintenance actually occurs in cyclical manner.

Maintenance (see TABLE "D") generally occurs in a cyclical manner and such cost would be minimal for the first number of years increasing sharply at times when major repairs or reconstruction would take place. Since it would be almost impossible to calculate the peaks of maintenance costs, we have established a fixed rate of cost at 1% per year for the terminal and 2% per year for the tank farm and pipeline. Launches, work-boats and transportation costs are based on an experienced estimate from other similar type facilities.

Depreciation is calculated on a life of 50 years for the major items of structure, pipelines and tank farm. Maintenance on the loading arms, hoses and instrumentation would probably replace all these items over the period of 50 years. Depreciation is utilized in the Profit and Loss Statement as it is possible or probable that a private entrepreneur, consortium, etc. may build this terminal. If government sponsored the depreciation would not be calculated.

Amortization and interest is based on mortgages or bonds of 50 year duration and a rate of 8-1/2% per annum. Amortization payments have been determined on a monthly payment schedule. In practice all the above is variable, but all costs have been maximized for demonstration purposes.

The Profit or Loss Statements are for illustrating the relative returns and benefits of each scheme and should be used for comparative purposes.

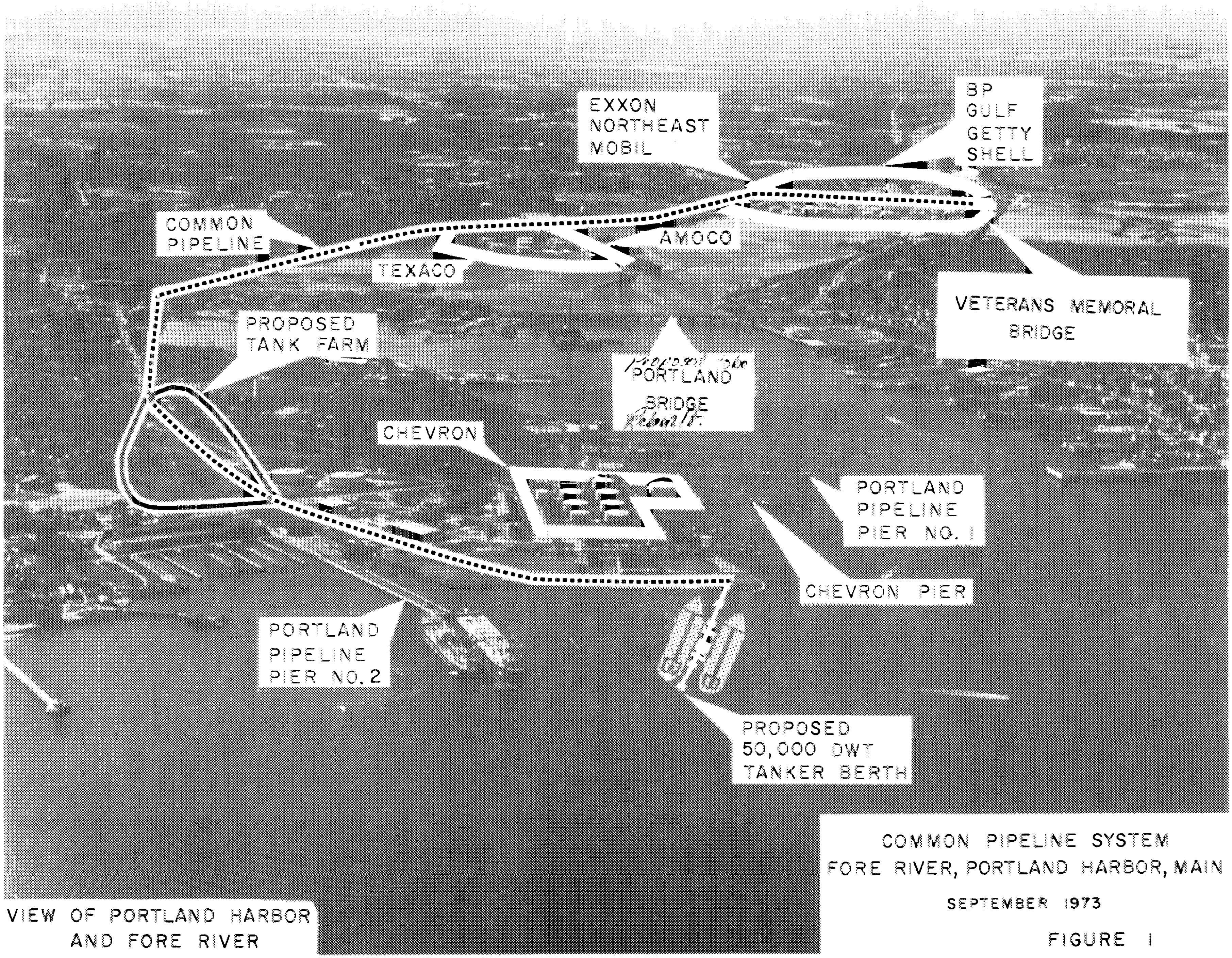
An examination of the Profit and Loss Statement indicates that the project is not only economically feasible, but potentially profitable. The freight savings in the utilization of larger tankers will more than compensate for the costs incurred. The present expense of the individually operated piers has deliberately not been calculated, but the new facility should provide a substantial savings benefit to all the terminals.

There has been no attempt to suggest who should finance, construct and operate this new facility. Obviously, there are many approaches to consider such as a consortium of the oil companies, a private operator or governmental agency.

It must be stated that under any scheme additional revenues will be available to the cities of Portland and South Portland. The economic benefits to the area will be in the possible reduction or at least holding of costs in the supply of petroleum for public consumption.

I. LIST OF FIGURES

J. LIST OF TABLES

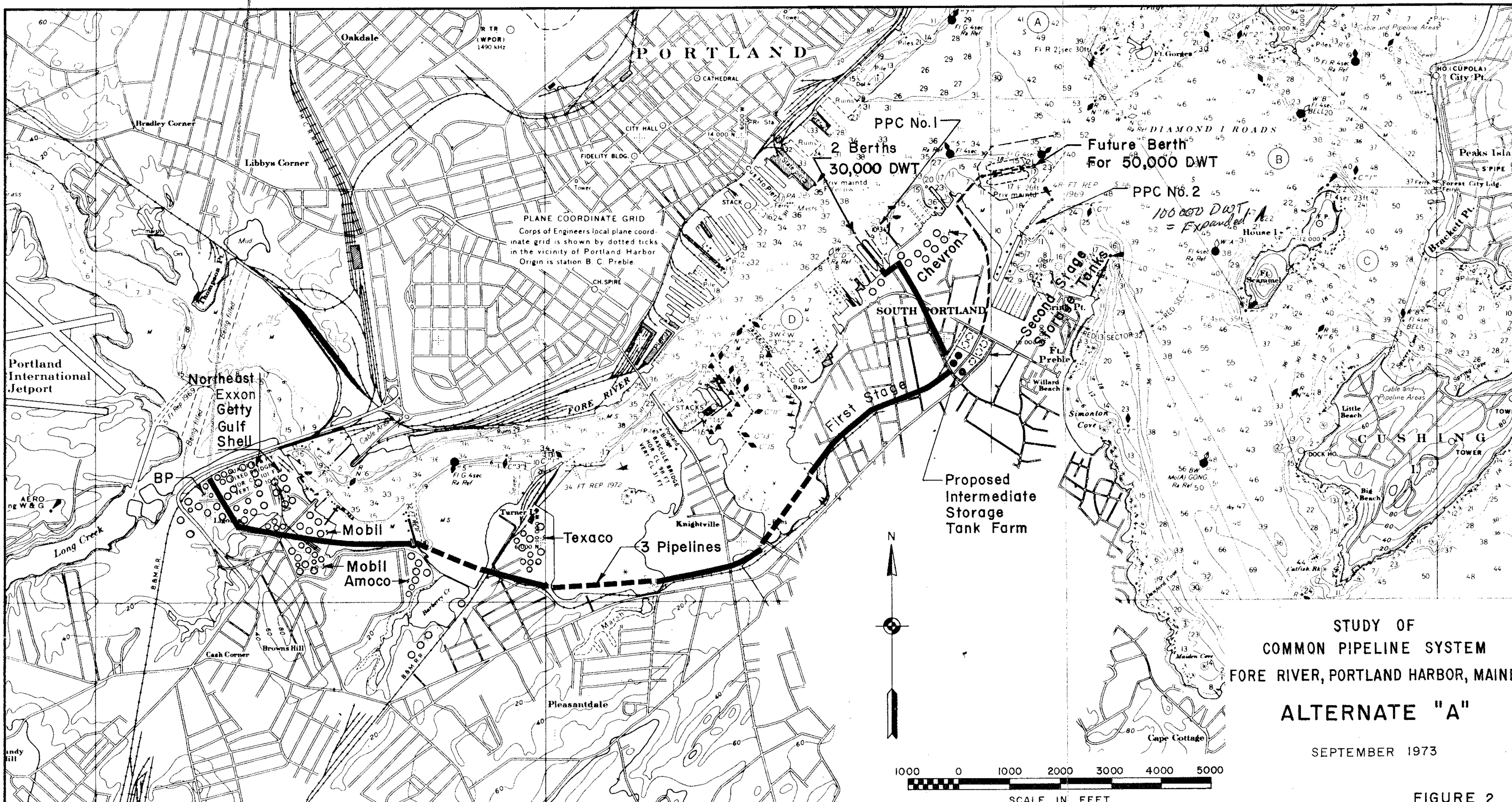


VIEW OF PORTLAND HARBOR
AND FORE RIVER

COMMON PIPELINE SYSTEM
FORE RIVER, PORTLAND HARBOR, MAIN

SEPTEMBER 1973

FIGURE 1

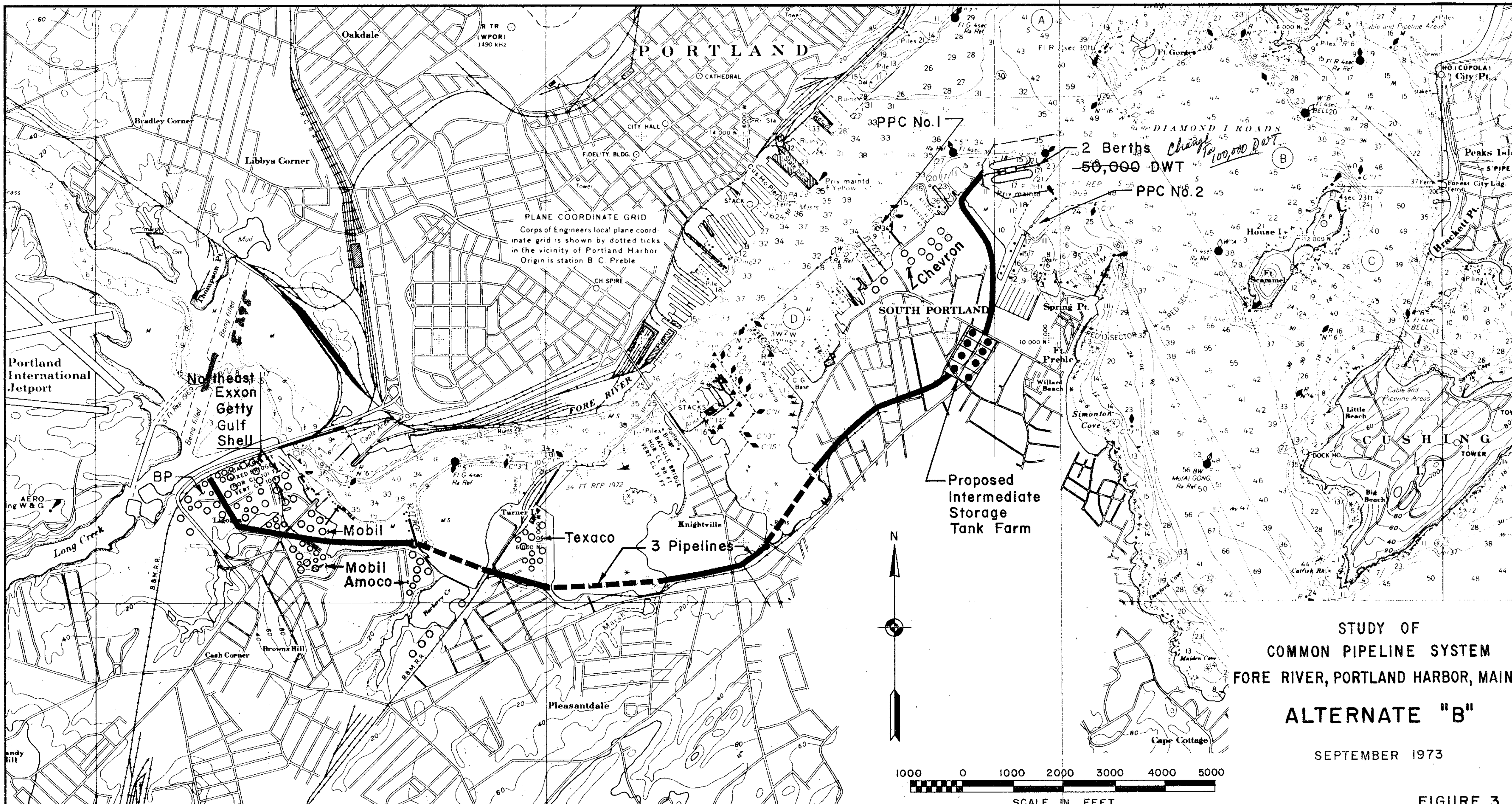


STUDY OF
COMMON PIPELINE SYSTEM
FORE RIVER, PORTLAND HARBOR, MAINE

ALTERNATE "A"

SEPTEMBER 1973

FIGURE 2

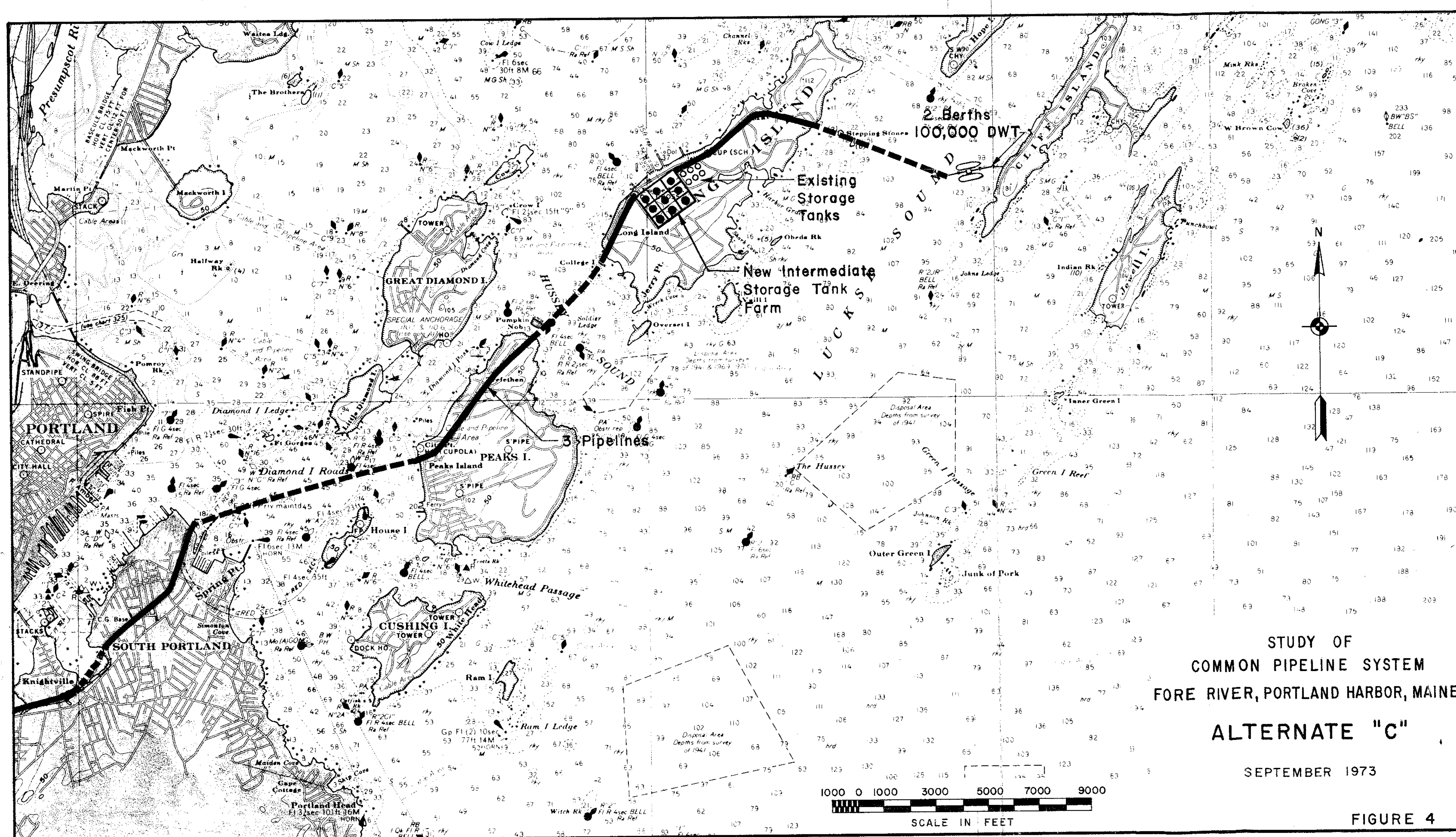


STUDY OF
COMMON PIPELINE SYSTEM
FORE RIVER, PORTLAND HARBOR, MAINE

ALTERNATE "B"

SEPTEMBER 1973

FIGURE 3

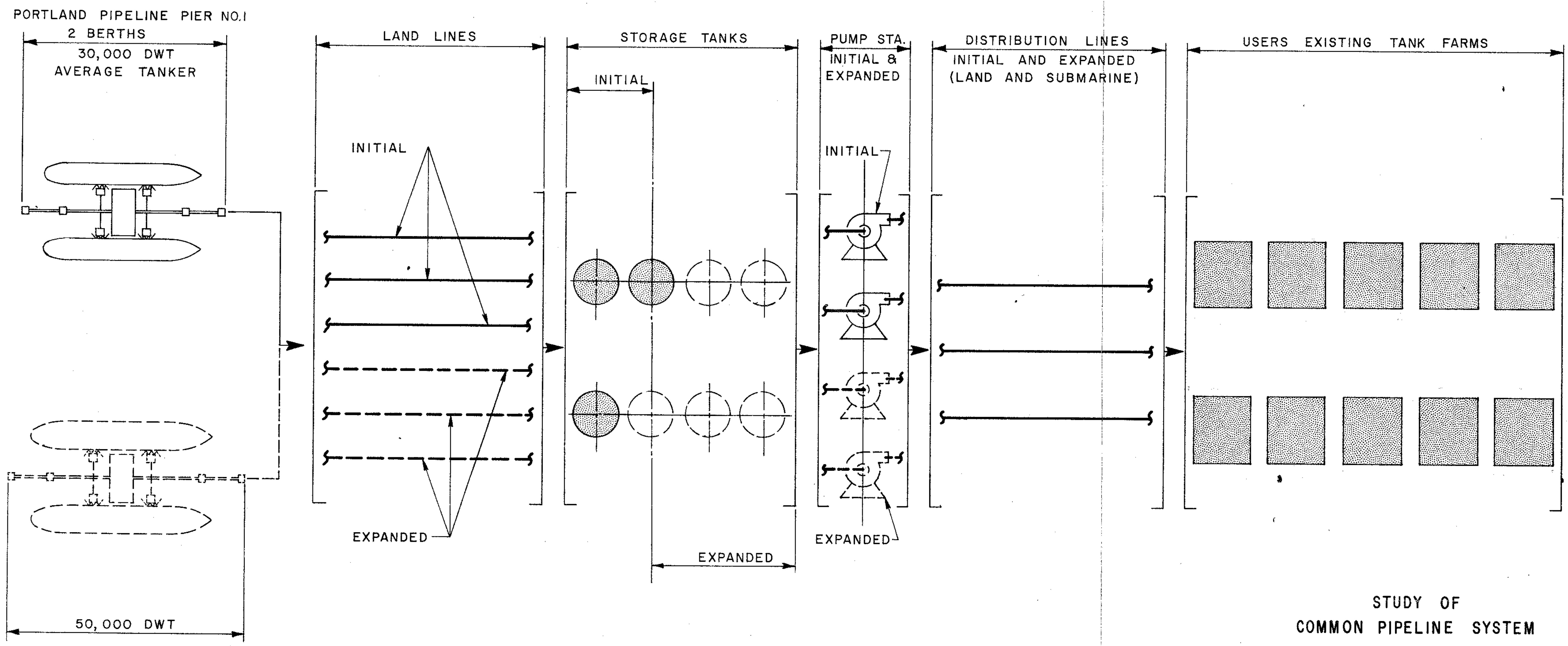


STUDY OF
COMMON PIPELINE SYSTEM
FORE RIVER, PORTLAND HARBOR, MAINE

ALTERNATE "C"

SEPTEMBER 1973

FIGURE 4

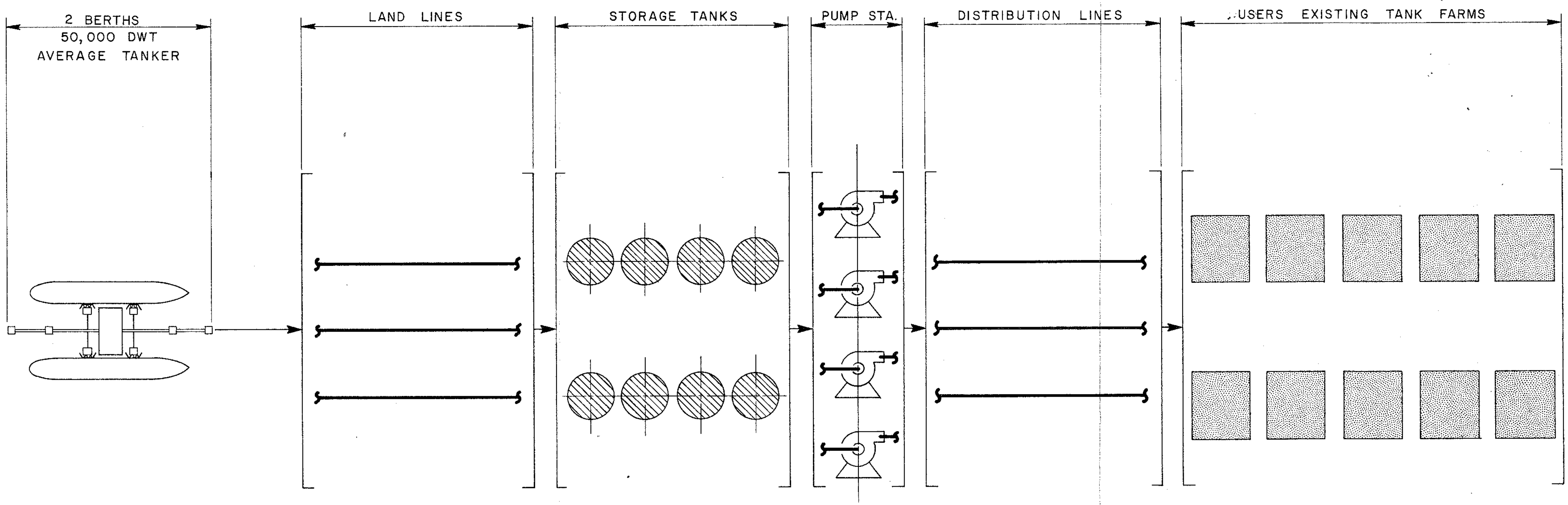


STUDY OF
COMMON PIPELINE SYSTEM
FORE RIVER, PORTLAND HARBOR, MAINE

SYSTEM FLOW DIAGRAM
ALTERNATE "A"

SEPTEMBER 1973

FIGURE 5

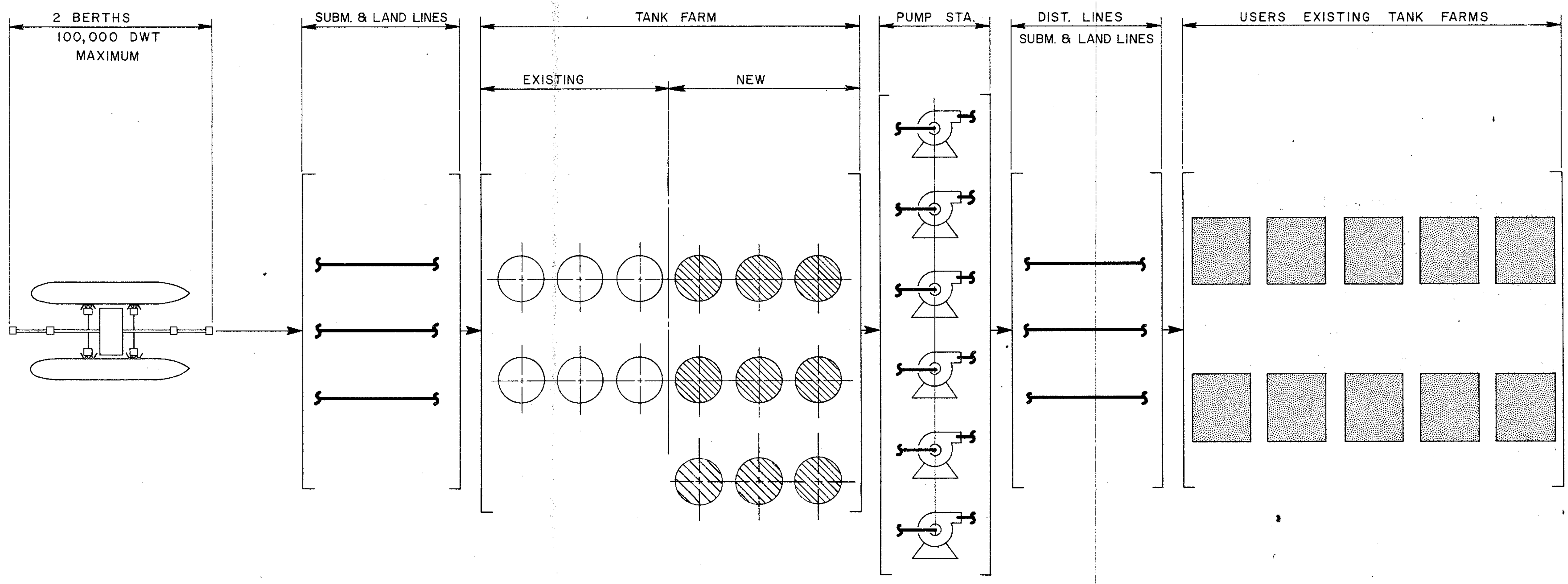


STUDY OF
COMMON PIPELINE SYSTEM
FORE RIVER, PORTLAND HARBOR, MAINE

SYSTEM FLOW DIAGRAM
ALTERNATE "B"

SEPTEMBER 1973

FIGURE 6

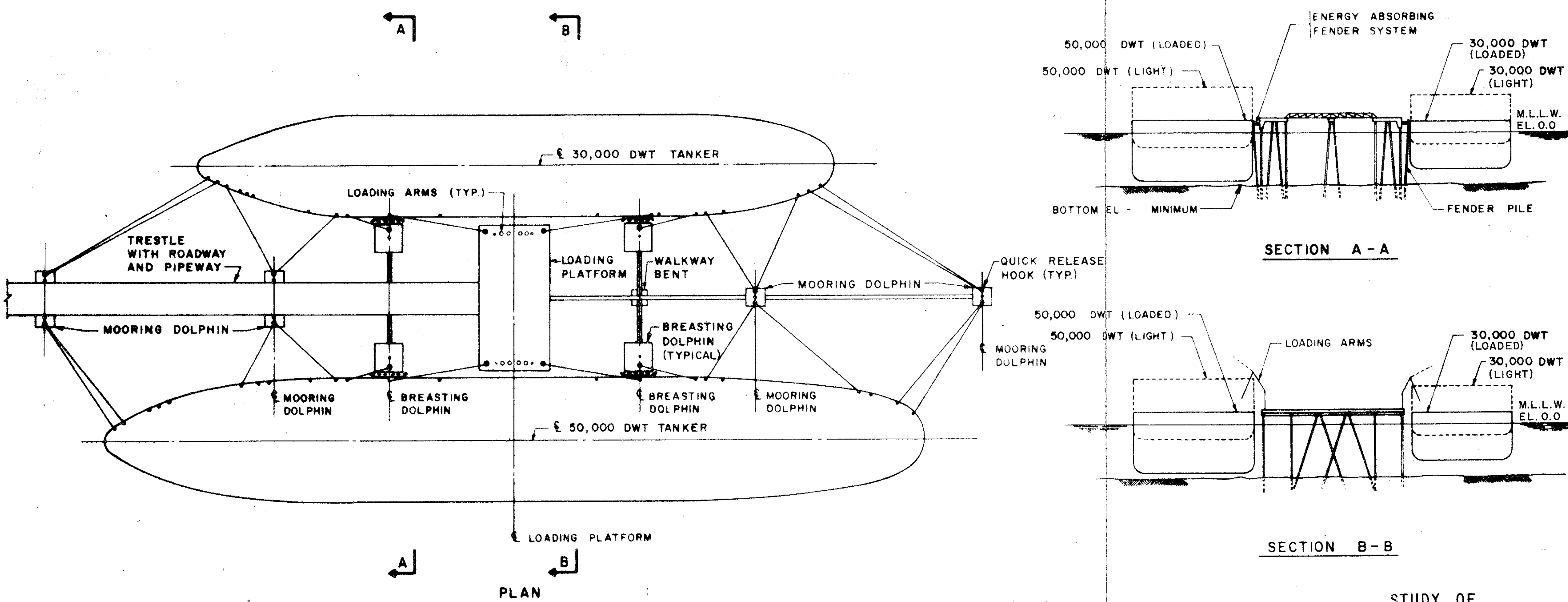


STUDY OF
COMMON PIPELINE SYSTEM
FORE RIVER, PORTLAND HARBOR, MAINE

SYSTEM FLOW DIAGRAM
ALTERNATE "C"

SEPTEMBER 1973

FIGURE 7

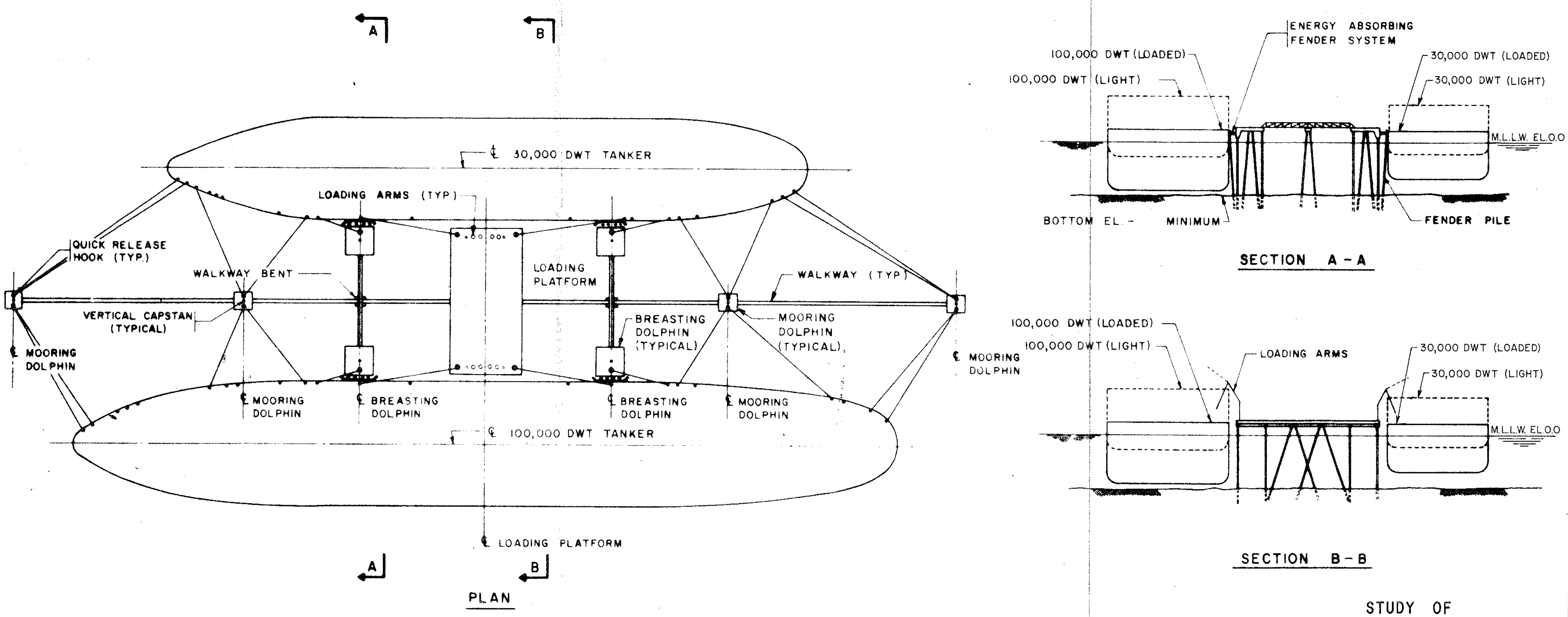


STUDY OF
COMMON PIPELINE SYSTEM
FORE RIVER, PORTLAND HARBOR, MAINE

FIXED PIER LAYOUT
ALTERNATE "B"

SEPTEMBER 1973

FIGURE 8

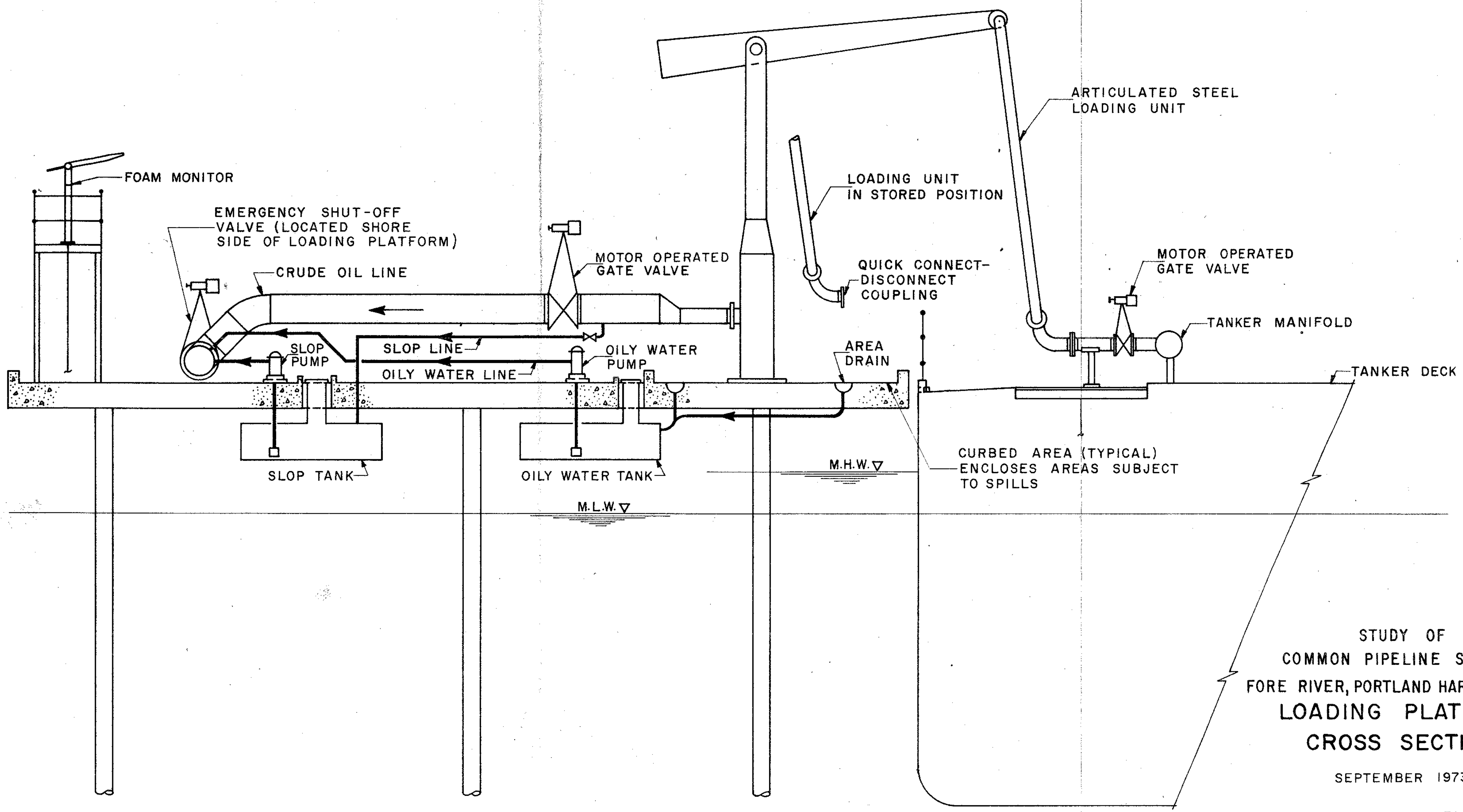


STUDY OF
COMMON PIPELINE SYSTEM
FORE RIVER, PORTLAND HARBOR, MAINE

FIXED PIER LAYOUT
ALTERNATE "C"

SEPTEMBER 1973

FIGURE 9

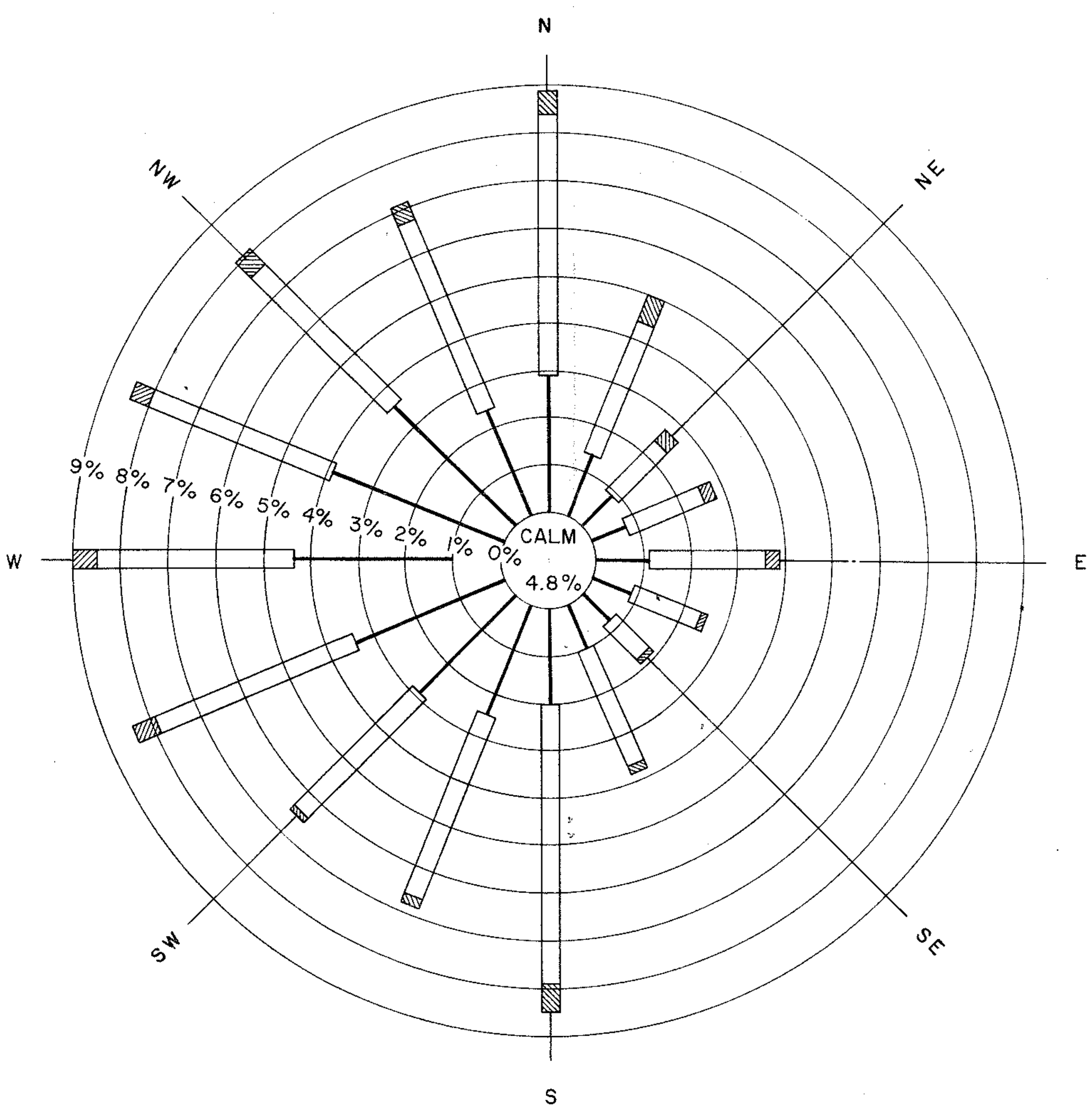


STUDY OF
COMMON PIPELINE SYSTEM
FORE RIVER, PORTLAND HARBOR, MAINE

LOADING PLATFORM
CROSS SECTION

SEPTEMBER 1973

FIGURE 10



LEGEND

WIND SPEED (MPH)

0-7 8-18 19-31

NOTES:

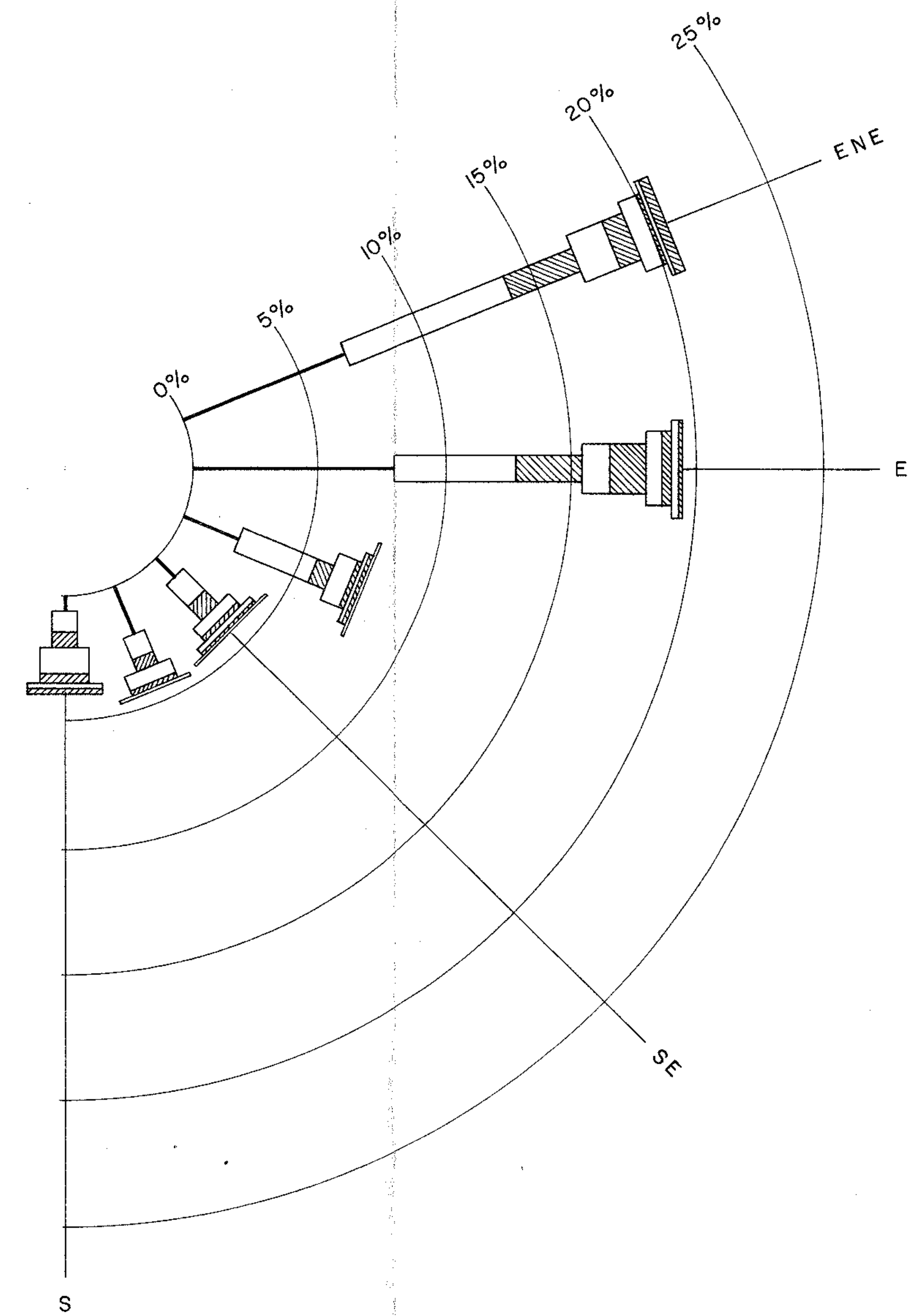
1. WINDS HIGHER THAN 31 MPH OCCUR LESS THAN 0.3 % OF THE TIME.
2. DATA BASED ON OBSERVATIONS BY THE U.S. WEATHER BUREAU AT PORTLAND CITY AIRPORT 1951-60

STUDY OF
COMMON PIPELINE SYSTEM
FORE RIVER, PORTLAND HARBOR, MAINE

WIND DATA

SEPTEMBER 1973

FIGURE 11



LEGEND

SIGNIFICANT WAVE HEIGHT
(FEET)

0-5- 2
2- 4
4- 6
6- 8
8-10
10-12
12-14
14-16
> 16

NOTES:

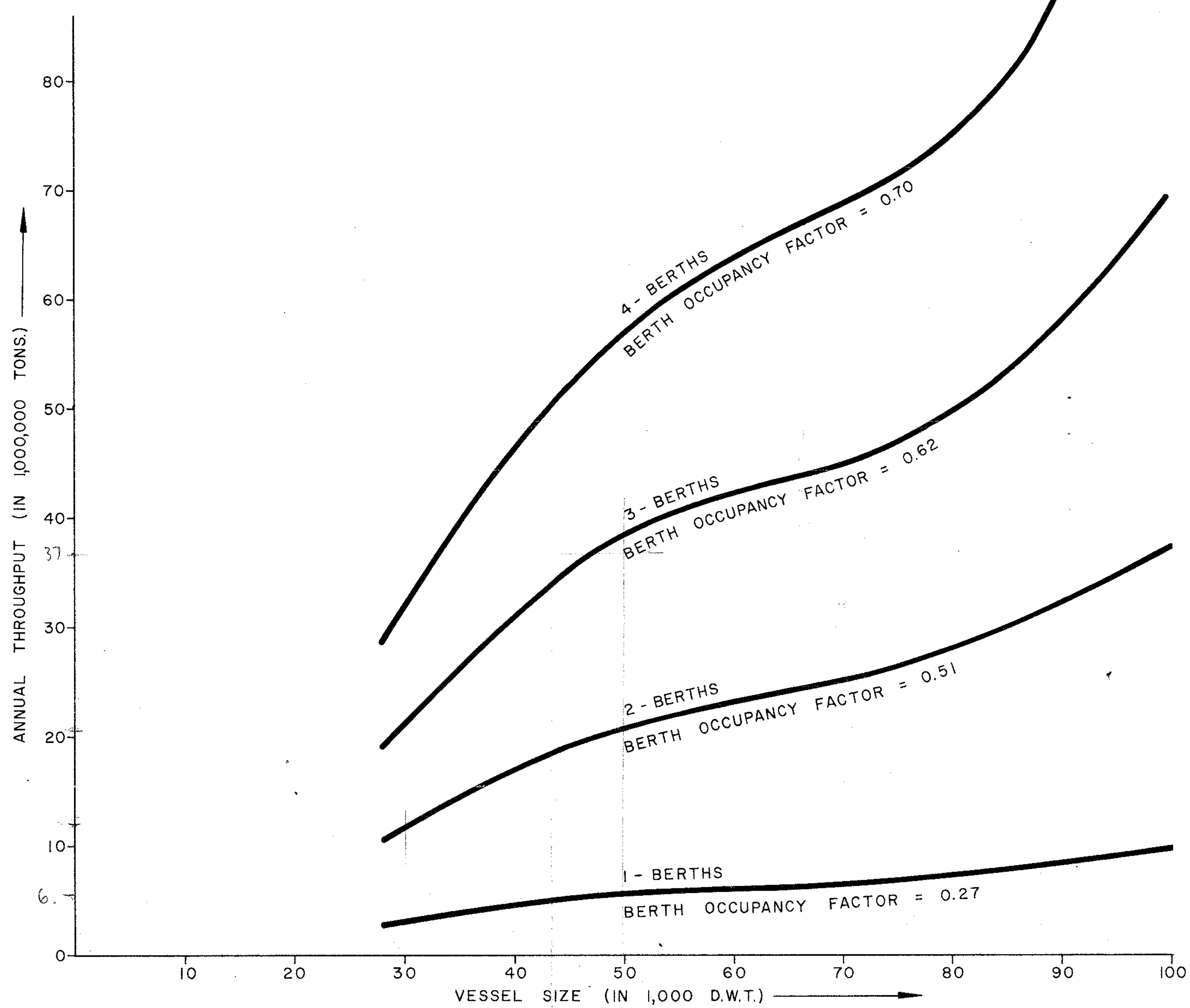
1. LENGTH OF BARS INDICATE OCCURENCE IN PERCENTAGE OF TIME.
2. CALM SEA OR WAVES FROM DIRECTIONS NOT SHOWN OCCUR 40.9 % OF THE TIME.
3. REFERENCE: NORTH ATLANTIC HINDCAST-BRETSCHNEIDER TECHNICAL MEMO No. 55.

STUDY OF
COMMON PIPELINE SYSTEM
FORE RIVER, PORTLAND HARBOR, MAINE

WAVE AND SWELL DATA

SEPTEMBER 1973

FIGURE 12



NOTE:

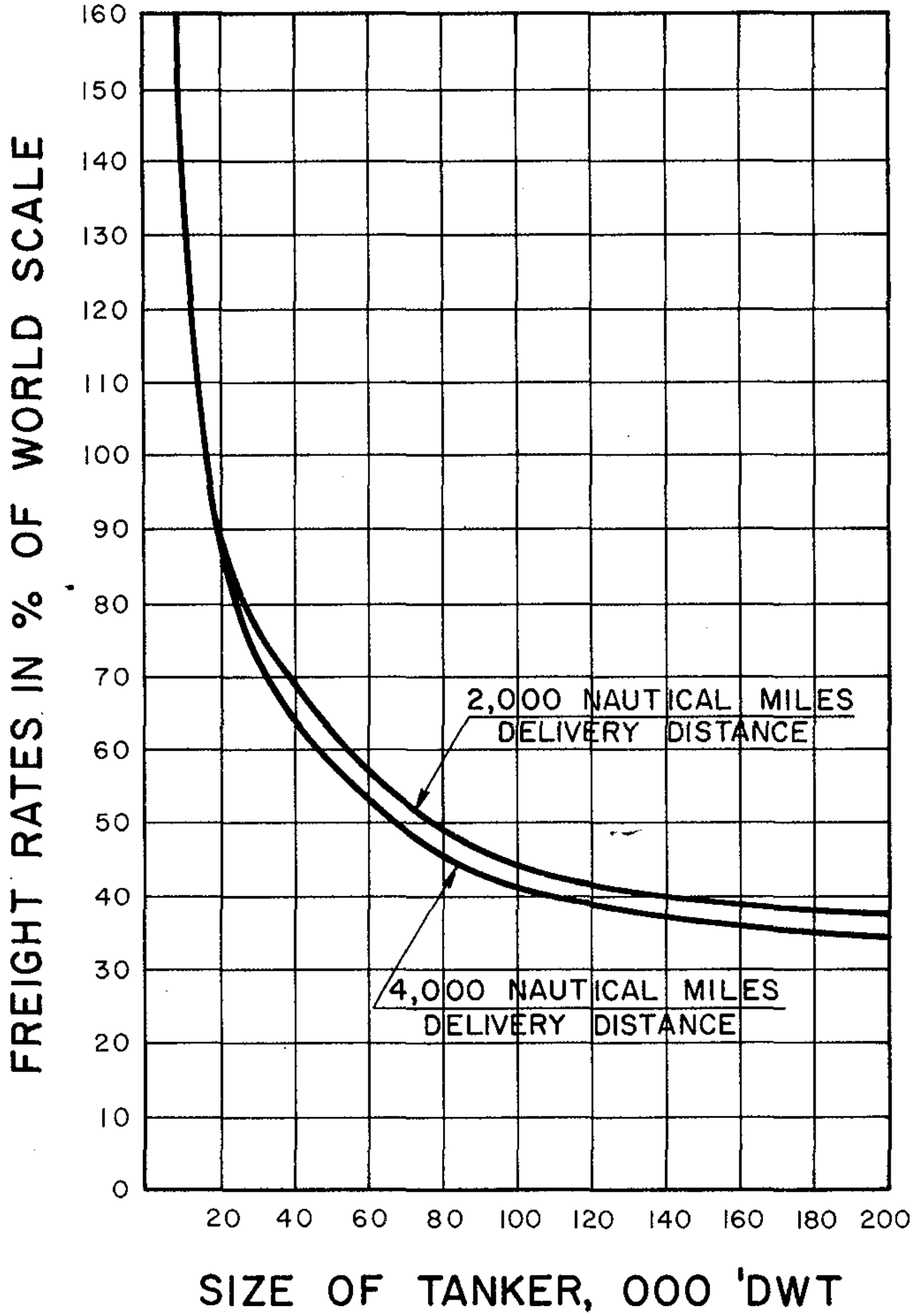
THROUGHPUT VS. VESSEL SIZE CURVES ARE BASED ON PERMISSIBLE RATIO OF WAITING TIME TO BERTH SERVICE TIME $t_w/t_b = 0.20$

STUDY OF
COMMON PIPELINE SYSTEM
FORE RIVER, PORTLAND HARBOR, MAINE

BERTH OCCUPANCY RATIO

SEPTEMBER 1973

FIGURE. 13



160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
FREIGHT RATES IN % OF WORLD SCALE
2,000 NAUTICAL MILES DELIVERY DISTANCE
4,000 NAUTICAL MILES DELIVERY DISTANCE
20 40 60 80 100 120 140 160 180 200
SIZE OF TANKER, 000 'DWT

FIGURE 14

TABLE 1

ALTERNATIVE "A" INITIAL
PROFIT & LOSS STATEMENT

CONSTRUCTION COST: $11,586,000

YEAR	INCOME @ .60 per ton	EXPENSE OPERATING	MAINT. & TRANS.	DEPREC. ST/LN.	AMORT.- & INTEREST 50 YR.-8½%	TOTAL EXPENSE	P/L NET
1973	$3,300,000	$ 285,000	$237,000	$231,720	$999,279	$1,752,999	$1,547,001
1974	3,630,000	299,250	"	"	"	1,767,249	1,862,751
1975	3,993,000	314,212	"	"	"	1,782,211	2,210,789
1976	4,192,200	329,923	"	"	"	1,797,922	2,394,278
1977	4,402,200	346,419	"	"	"	1,814,418	2,587,782
1978	4,578,000	363,740	"	"	"	1,831,739	2,746,261
1979	4,761,000	381,926	"	"	"	1,849,925	2,911,075
1980	4,903,300	401,023	"	"	"	1,869,022	3,034,778
1981	5,051,400	421,074	"	"	"	1,889,073	3,162,327
1982	5,202,600	442,128	"	"	"	1,910,127	3,292,473
1983	5,358,600	464,234	"	"	"	1,932,233	3,426,367
1984	5,519,400	487,446	"	"	"	1,955,445	3,563,955
1985	5,685,000	511,818	"	"	"	1,979,817	3,705,183
1986	5,856,000	537,409	"	"	"	2,005,408	3,850,592
1987	6,030,000	564,279	"	"	"	2,032,278	3,997,722
1988	6,212,400	592,493	"	"	"	2,060,492	4,151,908
1989	6,399,000	622,117	"	"	"	2,090,116	4,308,884
1990	6,591,000	653,223	"	"	"	2,121,222	4,469,778
1995	7,640,400	833,697	"	"	"	2,301,696	5,338,704
2000	8,857,200	1,064,032	"	"	"	2,532,031	6,325,169
2005	9,541,800	1,358,004	"	"	"	2,826,003	6,715,797
2010	10,279,800	1,733,196	"	"	"	3,201,195	7,078,605
2015	11,074,200	2,212,046	"	"	"	3,680,045	7,394,155
2020	11,929,800	2,823,193	"	"	"	4,291,192	7,638,608
2025	12,852,000	3,603,190	"	"	"	5,071,189	7,780,811

TABLE 2

ALTERNATIVE "A" EXPANDED
PROFIT & LOSS STATEMENT

CONSTRUCTION COST: $30,940,000

YEAR	INCOME	EXPENSE					
	@ .60 per ton	OPERATING	MAINT. & TRANS.	DEPREC. ST/LN	AMORT.- & INTEREST 50 YR.-8½%	TOTAL EXPENSE	P/L NET
1973	$ 3,300,000	$ 285,000	$501,000	$618,800	$2,675,175	$4,079,975	$ (779,975)
1974	3,630,000	299,250	"	"	"	4,094,225	(464,225)
1975	3,993,000	314,212	"	"	"	4,109,187	(116,187)
1976	4,192.200	329,923	"	"	"	4,124,898	67,302
1977	4,402,200	346,419	"	"	"	4,141,394	260,806
1978	4,578,000	363,740	"	"	"	4,158,715	419,285
1979	4,761,000	381,926	"	"	"	4,176,901	584,099
1980	4,903,800	401,023	"	"	"	4,195,998	707,802
1981	5,051,400	421,074	"	"	"	4,216,049	835,351
1982	5,202,600	442,128	"	"	"	4,237,103	965,497
1983	5,358,600	464,234	"	"	"	4,259,209	1,099,391
1984	5,519,400	487,446	"	"	"	4,282,421	1,236,979
1985	5,685,000	511,818	"	"	"	4,306,793	1,378,207
1986	5,856,000	537,409	"	"	"	4,332,384	1,532,616
1987	6,030,000	564,279	"	"	"	4,359,254	1,670,746
1988	6,212,400	592,493	"	"	"	4,387,468	1,824,932
1989	6,399,000	622,117	"	"	"	4,417,092	1,981,908
1990	6,591,000	653,223	"	"	"	4,448,198	2,142,802
1995	7,640,400	833,697	"	"	"	4,628,672	3,011,728
2000	8,857,200	1,064,032	"	"	"	4,859,007	3,998,193
2005	9,541,800	1,358,004	"	"	"	5,152,979	4,388,821
2010	10,279,800	1,733,196	"	"	"	5,528,171	4,751,629
2015	11,074,200	2,212,046	"	"	"	6,007,021	5,067,179
2020	11,929,800	2,823,193	"	"	"	6,618,168	5,311,632
2025	12,852,000	3,603,190	"	"	"	7,398,165	5,453,835

TABLE 3

PROFIT & LOSS STATEMENT
ALTERNATIVE "B"

CONSTRUCTION COST: $26,630,000

YEAR	INCOME	EXPENSE					
	@ .60 per ton	OPERATING	MAINT. & TRANS.	DEPREC. ST/LN	AMORT.- & INTEREST 50 YR.-8½%	TOTAL EXPENSE	P/L NET
1973	$ 3,300,000	$ 285,000	$490,000	$532,600	$2,302,500	$3,610,100	$(310,100)
1974	3,630,000	299,250	"	"	"	3,624,350	5,650
1975	3,993,000	314,212	"	"	"	3,639,312	353,688
1976	4,192,200	329,923	"	"	"	3,655,023	537,177
1977	4,402,200	346,419	"	"	"	3,671,519	730,681
1978	4,578,000	363,740	"	"	"	3,688,840	889,160
1979	4,761,000	381,926	"	"	"	3,707,026	1,053,974
1980	4,903,800	401,023	"	"	"	3,726,123	1,177,677
1981	5,051,400	421,074	"	"	"	3,746,174	1,305,226
1982	5,202,600	442,128	"	"	"	3,767,228	1,435,372
1983	5,358,600	464,234	"	"	"	3,789,334	1,569,266
1984	5,519,400	487,446	"	"	"	3,812,546	1,706,854
1985	5,685,000	511,818	"	"	"	3,836,918	1,848,082
1986	5,856,000	537,409	"	"	"	3,862,509	1,993,491
1987	6,030,000	564,279	"	"	"	3,889,379	2,140,621
1988	6,212,400	592,493	"	"	"	3,917,593	2,294,807
1989	6,399,000	622,117	"	"	"	3,947,217	2,451,783
1990	6,591,000	653,223	"	"	"	3,978,323	2,612,677
1995	7,640,400	833,697	"	"	"	4,158,797	3,481,603
2000	8,857,200	1,064,032	"	"	"	4,389,132	4,468,068
2005	9,541,800	1,358,004	"	"	"	4,683,104	4,858,696
2010	10,279,800	1,733,196	"	"	"	5,058,296	5,221,504
2015	11,074,200	2,212,046	"	"	"	5,537,146	5,537,054
2020	11,929,800	2,823,193	"	"	"	6,148,293	5,781,507
2025	12,852,000	3,603,190	"	"	"	6,928,290	5,923,710

TABLE 4

PROFIT & LOSS STATEMENT
ALTERNATIVE "C"

CONSTRUCTION COST: $48,060,000

YEAR	INCOME	EXPENSE					
	@ .60 per ton	OPERATING	MAINT. & TRANS.	DEPREC. ST/LN	AMORT.- & INTEREST 50 YR.-8½%	TOTAL EXPENSE	P/L NET
1973	$ 3,300,000	$ 285,000	$547,000	$961,200	$4,155,400	$5,948,600	$(2,648,600)
1974	3,630,000	299,250	"	"	"	5,962,850	(2,332,850)
1975	3,993,000	314,212	"	"	"	5,977,812	(1,984,812)
1976	4,192,200	329,923	"	"	"	5,993,523	(1,801,323)
1977	4,402,200	346,419	"	"	"	6,010,019	(1,607,819)
1978	4,578,000	363,740	"	"	"	6,027,340	(1,449,340)
1979	4,761,000	381,926	"	"	"	6,045,526	(1,284,526)
1980	4,903,800	401,023	"	"	"	6,064,623	(1,160,823)
1981	5,051,400	421,074	"	"	"	6,084,674	(1,033,274)
1982	5,202,600	442,128	"	"	"	6,105,728	(903,128)
1983	5,358,600	464,234	"	"	"	6,127,834	(769,234)
1984	5,519,400	487,446	"	"	"	6,151,046	(631,646)
1985	5,685,000	511,818	"	"	"	6,175,418	(490,418)
1986	5,856,000	537,409	"	"	"	6,201,009	(345,009)
1987	6,030,000	564,279	"	"	"	6,227,879	(197,879)
1988	6,212,400	592,493	"	"	"	6,256,093	(43,693)
1989	6,399,000	622,117	"	"	"	6,285,717	113,283
1990	6,591,000	653,223	"	"	"	6,316,823	274,177
1995	7,640,400	833,697	"	"	"	6,497,297	1,143,103
2000	8,857,200	1,064,032	"	"	"	6,727,632	2,129,568
2005	9,541,800	1,358,004	"	"	"	7,021,604	2,520,196
2010	10,279,800	1,733,196	"	"	"	7,396,796	2,883,004
2015	11,074,200	2,212,046	547,000	"	"	7,875,646	3,198,554
2020	11,929,800	2,823,193	547,000	"	"	8,486,793	3,443,007
2025	12,852,000	3,603,190	547,000	"	"	9,266,790	3,585,210